Status Report on the Couer d'Alene Salamander (*Plethodon idahoensis*) in Montana.

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Kootenai and Lolo National Forests

by

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Research Summary

Site descriptions and population estimates are given for 13 historically known, and 18 newly discovered Coeur d'Alene Salamander localities in Montana. The salamander is associated with three main habitat types; seepages, waterfall sprayzones, and at streamside on small, cascading creeks with dense overhead canopies. Underground refuge in these microhabitats is provided by fractured Belt bedrock or by colluvium interstices.

The Coeur d'Alene Salamander may be encountered in appropriate microhabitat below 5000 ft. elevation from the Canada boundary to the Bitterroot Valley, both in the Kootenai River drainage and in the Clark Fork River drainage west of 114^{o} W longitude. The northern and northeastern limit to the salamander's distribution is attributed to the Pleistocene presence of cordilleran ice sheets, the southern and southeastern limit to arridity and infrequent occurrence of appropriate microhabitat.

The most important abiotic factors influencing the distribution and abundance of the Coeur d'Alene Salamander include the hydric and thermal stability of the three microhabitat types. The most important biotic factor is the salamander's amensalistic interaction with humans. Recommendations for the preservation of the Coeur d'Alene Salamander in the face of this interaction are provided.

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Introduction

Description, natural history, and taxonomy of the Coeur d'Alene Salamander.

In their S.S.A.R. species account, Brodie and Storm (1970) adequately describe the appearance of the Coeur d'Alene Salamander (Plethodon vandyhei idahoensis) as follows. "A stocky, long-legged, western salamander of the genus Plethodon with parotoid glands, partially webbed toes, a modal number of 15 trunk vertebrae, and an uneven dorsal stripe. The ground color...of P. v. idahoensis is always black. A light, often irregular gular patch is usually due to the absence of melanophores" (see Photo. 1).

This salamander mates during autumn and, at some locations, spring. Females are reproductively active on alternate years and as with all Plethodon, probably attend the eggs and very early neonates. Eggs are likely deposited in underground refugia during April and May, and neonates first appear above-ground in October. Both sexes probably mature (~4.5 cm SVL) in their fourth year (see Houck, 1977; Lynch, 1984; Nussbaum et al., 1983).

The Coeur d'Alene Salamander is the only plethodontid of the northern Rocky Mountain region and one of only four urodeles found in Montana (Stebbins, 1985). The spotty distribution of this salamander covers regions below 5000 feet elevation in the Idaho panhandle and western Montana above the forty-sixth parallel (Stebbins, 1985), and likely extends north into British Columbia (Wilson et al., Ms.)

Despite the fact that it was discovered almost 50 years ago (Slater and Slipp, 1940), this unique element of the Pacific Northwest's herpetofauna has received little scientific attention. Available information on its natural history and ecology comes primarily from recent studies on its reproduction (Lynch, 1984) and foraging (Wilson and Larsen, Ms.), and from anecdotal accounts

in systematic studies (e.g. Brodie 1970), range extensions (reviewed by Brodie and Storm, 1970), and general herpetological treatments (e.g. Stebbins, 1951).

Of all known aspects of the Coeur d'Alene Salamander's natural history, perhaps the most unusual (and ecologically important) is its apparent high affinity for very wet microhabitat. It should be noted that all plethodontids lack lungs, and are necessarily closely associated with dampness because of their need to respire through a moist skin (Feder, 1983). In two eastern plethodontid lineages; the Desmognathinae and Hemidactyliini, aquatic and semi-aquatic habits are common in adults, and virtually all species have aquatic larvae. Species of Plethodon (and all other species in the remaining plethodontid lineages, the Bolitoglossini and Plethodontini) are remarkable, however, for their terrestrial (albeit damp-terrestrial) habits. These salamanders have no aquatic larval stage, and, for the most part, avoid extremely wet microhabitat (Bishop, 1943; Wake, 1966).

In eastern Northern America these terrestrial habits are believed to have been maintained by competitive interactions involving desmognathine and hemidactyliine plethodontids. In western North American, however, outside of the geographic range of the Desmognathinae and Hemidactyliini, the "semi-aquatic adaptive zone" has been exploited by three plethodontine species. There are the Black Salamander (Aneides flavipunctatus); Dunn's Salamander (Plethodon dunni); and Van Dyke's Salamander (Plethodon vandykei), the species (or species group) of which the Coeur d'Alene Salamander is part (Wake, 1966; Wilson and Larsen, Ms.).

Van Dyke's Salamander has been referred to as the most aquatic Plethodon (Brodie and Storm, 1971). Throughout its range it is often found at the edge of streams and in splashzones associated with waterfalls and seepages (Nussbaum et al., 1983; Wilson and Larsen, Ms.). It will enter water to escape danger

(Brodie, 1970) and forages upon aquatic insects in hydropetric areas (Wilson and Larsen, Ms.).

The ecological and historical importance of semi-aquatic habits in this species apparently differs between its two subspecies. The Washington Salamander (P. v. vandykei), which occupies the cool, damp coastal ranges and Cascade Mountains of Western Washington (a region with a rich urodele fauna), is hypothesized to avoid competition with other salamanders by residing in very wet microhabitat (Brodie, 1970). The same type of microhabitat in Idaho and Montana is important to the Coeur d'Alene Salamander, however, because of its hydric and thermal stability in what is reportedly the harshest climate experienced by any western Plethodon (Nussbaum et al., 1983; see Baily, 1980; Wilson and Larsen, Ms.). This stability permits salamanders residing in splashzones a longer foraging season than those living on talus slopes (Houck, 1977; Nussbaum et al., 1984; Wilson and Larsen, Ms.). It also results in a suitable environment for the invertebrates upon which salamanders feed (Wilson and Larsen, Ms).

The adaptive value of its having exploited this stable, insulating microhabitat may be best illustrated by the fact that the Coeur d'Alene Salamander is the only plethodontid that has persisted in a region that once had a milder climate and a more diverse plethodontid fauna (Thurow, 1968; Tihen and Wake, 1981). This fauna was presumably reduced by climatic changes occurring over the last 10-14 million years (Nussbaum et al., 1983).

Pleistocene and recent climatic changes resulted in the disjunction of eastern (P. v. idahoensis) and western (P. v. vandykei) populations of Van Dyke's Salamander (Wake, 1966), a peculiar geographic distribution shared by two other amphibians; the Pacific Giant Salamander (Dicamptodon ensatus) and the Tailed Frog (Ascaphus truei). This has, in part, spawned recurrent changes in the salamander's taxonomy.

While recognizing its unique (among the Plethodon) morphological similarities with Van Dyke's Salamander (e.g. webbed toes, subterminal digit pads, number of costal folds, and parotoid glands), Slater and Slipp (1940) assigned the Coeur d'Alene Salamander to species rank, implicitly because of its geographic separation from Van Dyke's Salamander, and explicitly because of its more elongate form, slight peculiarities in head shape, and, most important, because of its darker color. Lowe (1952), however, noting extreme similarities (even in coloration) between the Coeur d'Alene Salamander and a (then) newly collected series of Van Dyke's Salamanders from the Cascade Mountains, placed both in one species and generated the subspecies names we use here.

Current opinion on the taxonomy of Van Dyke's Salamander varies considerably. Brodie (1970) advocated sinking the two subspecies because morphological features do not vary concordantly across the species' range. This view was reiterated by Nussbaum et al. (1983) and seems to have been considered valid by Collins et al. (1982), as evidenced by their list of standard herpetological names. Contrasting with this view is that of Highton and Larson (1979) who, based on biochemical evidenced, suggested that the Coeur d'Alene Salamander be returned to full species. Adherents to the nomenclature of Highton and Larson view the Washington Salamander and the Coeur d'Alene Salamander as "cryptic species" (Larson, 1984) that cannot be reliably separated by morphological comparison. We use Lowe's (1952) nomenclature out of convention.

Scope of this study.

The first discovery of the Coeur d'Alene Salamander in Montana was by E. K. Teberg at Big Hoodoo Mountain in 1962 (Teberg, 1964). Prior to our survey, the salamander had been reported from 21 sites in Idaho (C. Groves, pers. comm.)

and from 13 sites in Montana. At present, 31 Montana sites are known (see Sect. R1 and Map 19).

During this study we divided our efforts between three tasks. First, we sought to describe the habitat and assess the populations of historical Montana sites. Second, we attempted to delimit the salamander's distribution in Montana by locating new populations. Finally, by comparing all sites, we have tried to gain a better picture of the microhabitat associated with the salamander. By these means we hope to have produced an account of some value to individuals trying to locate additional Coeur d'Alene Salamander populations and to those making decisions that may result in modification of the natural environment, and possibly affect the distribution and abundance of this unique vertebrate.

Materials and Methods

Field work in this survey was performed between 15 May and 15 June, 1987. This period was selected so that work would coincide with favorable weather (i.e. damp and cool weather, conducive to surface activity of the salamander. See Wilson and Larsen, Ms.). We also took one survey trip, wholly devoted to site photography, between 21 and 23 August, 1987.

Locating populations.

We spent considerable time examining Forest Service and U.S.G.S. topographic maps in preparation for our field survey. Our interest centered around areas under 6000 feet elevation with apparently substantial water tables (indicated by lakes in adjacent, higher elevations). In these areas we looked for steep, first order streams and waterfalls. With the idea of field-surveying a large geographic area in a relatively short time, we paid particular attention to potential sites accessible by car or short hike. Our discovery of the Surprise Gulch, Yaak Falls, Sims Creek, and Sweathouse sites (see Sect. R1) came as a result of these preparatory efforts. While in the field, we also searched areas as we encountered them, based upon an apparent high likelihood of locating suitable Coeur d'Alene Salamander microhabitat, and upon information from local residents.

Habitat Characterization.

Reported distances were obtained from car odometer, highway mileage markers, and tape measure; or by examining topographic maps and scaled photographs. We obtained elevations from topographic maps, except in one case (Sect. R1; Troy 3) when we used an altimeter. Slopes were measured with a clinometer or were obtained from topographic maps. In the interest of having the information in this report easily used with conventional equipment and

materials (e.g. car odometers and topographic maps), we report elevations and highway distances in feet and miles, respectively.

Indicated habitat types are from Pfister et al. (1977). Our use of the expression "% overstorey" is in the sense of Herrington and Larsen (1985) and is intended as an index of the shade afforded a site by tall plants.

Salamander observations.

Day counts were performed by digging or moving moss, wood, and rock in damp areas along streams or in the splashzones of seepages and waterfalls. Night counts involved searching such areas with a flashlight when it was subjectively determined to be "dark enough". Since Coeur d'Alene Salamanders wander considerably during damp weather (Wilson and Larsen, Ms.), we searched an area 5 m out from the edges of splashzones and creeksides.

All temperature measurements were made with mercury thermometers. Temperatures during the day preceeding a night count, and the number of day's since the last rainfall, were either measured by us or obtained from Forest Service data.

When a salamander was encountered it was judged, on the basis of size, to be an adult or immature, and the temperature of the substrate in contact with the salamander was measured (see Bogert, 1952). This substrate was then classified as to type and wetness. The size of the predominant rock fragments in association with a given salamander was indexed as follows. Rock 1 (sand), fragment diameter <0.5 cm; Rock 2 (gravel), fragment diameter >0.5 cm but <4 cm; Rock 3, fragment diameter >4 cm but <20 cm; Rock 4, fragment diameter >20 cm.

To characterize substrate wetness we used Dumas' (1956) index as follows. Wetness 1 (damp), substrate only discolored by moisture; Wetness 2 (moist), minute water droplets visible on substrate; Wetness 3 (wet), thin film of water

covering substrate; Wetness 4 (very wet), puddles of water or water flowing over substrate.

It should be noted that substrate characterizations took enough time that adjacent salamanders were disturbed. For this reason, the number of salamanders we counted at any given site (especially at night) is likely lower than it would be otherwise (see Sect. R1; Troy 16).

One or two voucher specimens were collected from newly discovered sites. These were anesthetized with MS222, killed and fixed in 10% formalin, and preserved in 70% ethanol. Specimens are to be deposited in the herpetological collection at Montana State University, Missoula.

Survey expenses.

To facilitate planning of future surveys of the type we have conducted, we include this account of our major expenses. We have not included the cost of food purchased during field work or transportation costs stemming from our survey of 21-23 August.

Transportation; 6000 miles at 21 cents per mile (this is the rate paid by both Washington and Montana)	$1,260.00
Travel expenses (campground-lodging, showers, and laundry)	75.00
Report costs (photography, photocopying, paper, and typing)	170.00
Total expenses	$1,505.00

Results

Section R1. Site descriptions.

As of the completion of our survey, the Coeur d'Alene Salamander has been reported from 31 sites (Map 19). Except for being grouped according to their associated river drainages, these sites are described here in no particular order. In naming sites, we have conserved those names already in Nature Conservancy records. Sites that may share a single, dispersed salamander population are given subcategorized names (e.g. the Troy 1 sites). Data characterizing salamanders and associated substrates are given in Section R2.

Troy 2 (historical site).

Kootenai National Forest in Lincoln Co. Kootenai River drainage. Salamanders found in a close series of rocky seepages and in culverted runoff on a northfacing roadcut due ESE of Troy. Site is on U.S. Highway 2, 4.2 miles from the Lake Creek bridge at Troy city limits. Elevation is 2000 ft. U.S.G.S. quad: Kootenai Falls 7.5 min. In sect. 15; T31W, R32W. 48°, 26′, 41" lat., 115°, 47′, 59" long. See Map 1.

History: We were informed of this site by J. E. Lynch, who assumed it was known to E. K. Teberg. Neither Teberg nor P. C. Dumas (pers. comm.) recall finding salamanders here. Salamanders in this site were used in a study by Lynch (1984).

Site description: There are three heavily flowing springs that emerge at roadside from a cut into a 15° slope (Photo 2a). Water from the seepages is culverted to the north side of the highway where it cascades ~3 m into a pool alongside railroad tracks (Photo 2b). North of the rails it emerges from a culvert and travels NW ~200 m to the Kootenai River in a small, smooth flowing brook. Water flow is constant during the summer.

Local habitat type is PSME/SYAL. Dominant trees include Pseudotsuga menziesii, Larix occidentalis, and Pinus ponderosa. Shrubs in the area include Symphocarpos alba, Acer glabrum, Cornus stolonifera, Betula sp., Ribes sp., and immature conifers. Above the seepages there is a ~50% overstorey and above the cascade area north of the highway overstorey is scant. The seepages comprise ~70 m^2 of a 3 m high dripzone that extends along ~40 m of highway. The underlying rock is lightly fractured Belt mudstone. This rock is almost completely covered by bryophyte mat with mixed grasses and forbs including Equisetum arvense, Mimulus guttatus, and Ranunculus sp. The cascade area north of the highway is composed of gravelly riprap with a splashzone of 6 m^2.
Observations: We counted salamanders here in the early morning of 4 June. Air temp. was 13.3°C and the sky was clear. The high daytime temp. on 3 June was 25°C and the last rainfall had occurred on 1 June. Emergent water temp. at the start of the count was 8.3°C. We found 11 salamanders; two in the seepages, and nine in the cascade area and at poolside north of the highway.
Population: This is probably a small-medium sized population. The relatively high density of salamanders in the Cascade area north of the highway indicates this to be the best local microhabitat. Our observations are consistent with several casual counts we performed here in 1985 and 1986. Except during rainy periods, this population is likely restricted to the area around the highway and railroad: we unsuccessfully searched 50 m of the creek below the railroad and the slopes from which the seepages emerge are too dry to support plethodontids (also see Sect. R3; 17).

Teberg's sites: Troy 1a, 1b, 1c, 1d, 1e (historical sites).

Kootenai National Forest in Lincoln Co. Kootenai River drainage. Salamanders found in a series of rocky seepages on a NW facing roadcut due ESE of Troy. These sites occur along ~800 m of the south side of U.S. Highway 2;

distances indicated are from the Lake Creek bridge at Troy city limits. Elevation is 2000 ft. U.S.G.S. quad: Kootenai Falls 7.5 min. In sect. 14; T31N, R32W. Seepages centered around 115°, 45′, 36" long., 48°, 26′, 57" lat. See Map 1.

History: The Coeur d'Alene Salamander was first collected in this area (Troy 1b?) by Teberg in 1962 (Teberg, 1964). Studies on the salamander's life history (Lynch, 1984) and foraging (Wilson and Larsen, Ms.) used animals from these sites. The first report of predation upon the salamander stemmed from observations at Troy 1b (Wilson and Simon, 1985).

General description: Water in these sites emerges from fractured Belt rock on the south side of an easement 30 m above the Kootenai River. Portions of this easement are supported by concrete fill (Photo. 3a, 3b). All described seepages are perennial. The steep (~45°) slopes above the bare cliffs at the river's edge are forested primarily in the PSME/SYAL habitat type which grades into SCREE and THPL/CLUN. Because Coeur d'Alene Salamanders can travel widely during rainy weather, the isolated seepages here may support a single dispersed population.

Troy 1a.

Site is 5.1 miles from the Lake Creek bridge.

Site description: This is a boggy seepage of fairly heavy flow. It lies 4 m from the highway at the base of a 20° soil covered, forested slope (Photo. 4). Emergent water pools in a highwayside ditch that extends along 70 m of highway. It is allowed to percolate to the river below, where it appears as a series of damp areas at the river's edge. The immediate area is forested in Pseudotsuga menziesii and Larix occidentalis. There is a ~50% overstorey of Acer glabrum and Betula sp. The seepage comprises 16 m^2 of a dripzone that includes 3 m^2 of exposed bedrock, above soil and gravel sloping to the highwayside ditch. The

seepage is almost entirely blanketed by bryophyte mat with mixed grasses and forbs including Equisetum arvense and Ranunculus sp.

Observations: We censused this area in the early morning of 4 June. Air Temp. was 14.4°C, emergent water temp. was 7.8°C, and the sky was completely clear. The high daytime temperature on 3 June was 25°C and the last rainfall had occurred on 1 June. We found one salamander.

Population: This seems poor microhabitat and supports a small population at best. We sought salamanders here four times in 1986 and were able to collect only a single specimen. Except during rainy weather salamanders are likely restricted to the area we searched: A day search of the riverside runoff from this seepage yielded no salamanders and the slopes surrounding this seepage are too dry to support plethodontids.

Troy 1b.

The western extent of this site begins 5.2 miles from the Lake Creek bridge.

Site description: This is a series of three rocky seepages in vertical, well fractured rock along 60 m of roadway (Photo. 5a). The westernmost seepage comprises ~25 m^2 of wet cliff averaging 4 m high (Photo. 5b). This seepage is separated from the middle one by 4 m of dry rock. The middle seepage comprises ~130 m^2 of cliff and averages 6 m in height (Photo. 5c). The easternmost seepage is separated from the middle one by 18 m of dry rock and includes ~80 m^2 of damp cliff averaging 10 m high (Photo. 5d). Rubble has accumulated at the bases of the seepages and a damp splashzone extends horizontally 1-3 m. Water pools in a 1 m wide roadside ditch (Photo. 5e), percolating below the highway to damp areas at riverside. The westernmost and middle seepages drain into a single 30 m long pool.

The slopes above the seepages are composed largely of scree and bare cliffs or are forested in Pseudotsuga menziesii. Shrubs and small trees above and within the seepages include Acer glabrum, Betula sp., Cornus stolonifera, Ribes sp., and immature conifers. The ground and rock within the seepages is covered to varying degrees by bryophyte mat with grasses and forbs including Equisetum arvense, Mimulus guttatus, and Ranunculus sp. The westernmost seepage is a heavily flowing spring with a ~60% overstorey. Bryophyte mat covers less than 15% of rock surface. The overstorey of the middle seepage is ~20% and that of the easternmost seepage is scant. Both of these seepages involve light, dripping water flow and have bryophyte mat covering 50-70% of rock surface.

Observations: We performed a night count of salamanders at this site on 31 May and a day count on 4 June. At the start of the night count air temp. was 7.2°C, emergent water temp. was 6.7°C, and the sky was completely overcast. On the preceeding day rain had fallen and the high air temp. was 10.6°C. We counted 57 salamanders; nine in the westernmost seepage, 25 in the middle seepage, and 23 in the easternmost seepage.

At the start of the 4 June day count air temp. was 21.1°C, emergent water temp. was 8.3°C, and the sky was clear. The last rain had fallen on 1 June. We found eight salamanders, four in the middle seepage and four in the easternmost seepage, in ~20 minutes.

Population: These seepages support a very large salamander population. During 1985 and 1986 we could usually count 120-140 salamanders here in climate similar to that we encountered on 31 May 1987. The low count we made on that night is attributed to our substrate assessment methods. The distribution of salamanders we observed during our night count was consistent with what we have observed in the past. The poorest microhabitat seems to be that found in the westernmost seepage.

Except during rainy periods, salamanders are restricted to the seepage splashzones. On rainy nights in 1985 and 1986 we found individuals as far as 10 m from these zones. Areas surrounding the seepages are generally too dry to support plethodontids. We searched the riverside runoff from these seepages on 5 June and 6 June and found no salamanders. These damp areas are mostly below the river's high water marks. We also unsuccessfully searched damp, bryophyte covered scree ~30 m above the seepages.

Troy 1c.

This site is 5.3 miles from the Lake Creek bridge.

Site description: This is an unstable, rocky seepage of heavy fracturing and medium flow. It is at the base of a bare, 40^{o} eroded gravel and rubble slope. The highway department has hung chain link over the area at roadside to contain falling rock (Photo. 6). Emergent water pools at the base of the seepage and percolates to the river below, apparently entering below waterline.

What little undisturbed habitat there is above and around the seepage includes bare rock, scree and slopes forested in Pseudotsuga menziesii. There is no tree or shrub overstorey. Ground cover is scant and bryophyte mat covers less than 10% of rock surfaces. The seepage comprises ~25 m^2 of vertical rockface that rises 6 m above a 1 m wide dripzone in rubble and boulders that have accumulated at highwayside. Dirt and sand overlay much of this rock pile. A damp strip of sand is visible on the slope above the seepage.

Observation: We censused salamanders here on the night of 3 June. Air temp. was $14.4^{o}C$, emergent water temp. was $7.2^{o}C$, and the sky was completely clear. High daytime temp. on 3 June was $25^{o}C$ and the last rain had fallen on 1 June. We counted 16 salamanders.

Population: This seepage supports a healthy, medium sized population. We have counted up to 50 salamanders here on nights in 1985. This is consistent with

the observation of R. L. Wallace (pers. comm.) who collected ~30 salamanders here one night in 1986. Except during rainy periods, the population is likely restricted to the roadside seepage area and the damp portion of the eroded slope above. Surrounding areas seem too dry to support plethodontids.

Troy 1d.

The western extent of this site begins 5.4 miles from the Lake Creek bridge.

Site description: This is a damp strip of soil-covered roadcut fed by small, heavily flowing seepages along 150 m of roadside (Photo. 7a). Much of the original 35-40^{o} slope persists along the road here and many vertical rockfaces of 1 to 3 m high are exposed (Photo. 76). Water from the seepages flows along a 1 m wide highwayside ditch and at the western extent of this site is culverted beneath the highway and rail easement. It emerges from a riprap ~75 m away and at two locations drops into the Kootenai River (Photo. 7c).

The slope above the seepages is forested in Pseudotsuga menziesii, Larix occidentalis, Pinus ponderosa, and Thuja plicata. These seepages are overstoreyed up to 50% by Acer glabrum, Betula sp., Cornus stolonifera, Ribes sp., and immature conifers. There is a deep ground cover of bryophyte mat with grasses and forbs including Equisetum arvense, Mimulus guttatus, and Ranunculus sp.

Observations: We counted 11 salamanders here on the night of 3 June. Air temp. was 15.6^{o}C, emergent water temp. was 6.7^{o}C, and the sky was completely clear. High daytime temp. on 3 June was ~25^{o}C and the last rainfall had occurred on 1 June. All salamanders were found in the vicinity of the few exposed patches of damp bedrock that appear at the site.

Population: Salamanders here are sparsely distributed over several hundred m^2 of damp area. The population is probably small-medium. The best microhabitat

seems to be in areas of exposed rock rather than in the surrounding bryophyte covered areas. We counted 15 salamanders here one rainy night in 1985. We have unsuccessfully searched the riverside runoff on several visits in 1985 and 1986, and on 5 June 1987. The population is probably restricted to the damp roadside area.

Troy 1e.

This site is 5.6 miles from the Lake Creek bridge.

Site description: This is a rocky seepage of light water flow. It involves ~80 m^2 of a 10 m high vertical cliff and a 1 m wide dripzone below. The cliff is heavily fractured (Photo. 8). The ground at the base of the cliff is covered with highway sand and pooled water here percolates to the river below. The slope above the seepage is forested in Pseudotsuga menziesii, Larix occidentalis, Thuja plicata, and Pinus ponderosa. Directly associated with the site are Betula sp., Cornus stolonifera, Ribes sp. and immature conifers. There is no shrub-tree overstorey. Less than 20% of the seepage area is covered in bryophyte mat. Other ground cover includes grasses and forbs including Equisetum arvense and Solidago sp.

Observations: We counted 34 salamanders here on the night of 3 June. Air temp. was 16.1°C, water temp. was 6.7°C and the sky was clear. High daytime temp. on 3 June was ~25°C and the last rain had fallen on 1 June.

Population: This is a medium-large population. The highest number of salamanders we ever counted here was 62 in 1985. Except during rainy nights the salamanders are probably restricted to the seepage, as surrounding areas seem generally too dry to support plethodontids.

The high incidence of hardwood stands and the THPL/CLUN habitat type on the slopes above the Teberg sites indicate this area may be rich in seepages and salamander populations (see Troy 3 and Sect. R3; 19, 20).

"roadent" = roadcut

Troy 3 (new site).

Burlington Northern land in Lincoln Co. Kootenai River drainage. Salamanders found in a rocky seepage on a northfacing roadent due east of Troy. Elevation is 2200 ft. Site is on the south side of the old Troy-Libby highway, 0.4 miles from its junction with U.S. Highway 2. This junction is 6.2 miles from the Lake Creek bridge in Troy. U.S.G.S. quad: Kootenai Falls 7.5 min. In sect. 13; T31N, R32W. 48°, 27′, 5" lat., 115°, 45′, 50" long. See Map 1.
Site description: This is a series of lightly flowing seepages on a cut into a 40° slope. Water from the seepages flows down ruts in the abandoned easement's bed, eventually percolating below the surface (Photo. 9a). This is likely a permanent seepage: flow did not decrease substantially between 4 June and 20 August.

The predominant habitat type is PSME/SYAL grading into THPL/CLUN and SCREE. There is a talus slope immediately below the easement in the area of the site. Dominant trees include Psendotsuga menziesii, Larix occidentalis, Thuja plicata, and some Pinus ponderosa. The site has a 50% overstorey of Betula sp. and immature Thuja plicata. Other local shrubs include Cornus stolonifera, and Rosa sp. Ground cover at the site comprises bryophyte, grasses, and forbs; Rubus parviflora and Equisetum arvense. The seepages dampen an area of fractured, 3 m high Belt rockface, 30 m long. Bryophyte mat covers less than 10% of the rockface surface. At the base of the rockface rubble has accumulated.

Observations: We found four salamanders in a 45 minute search here on 4 June 1987. Air temp. was 19.4°C, emergent water temp. was 8.3°C, and the sky was clear. The last rain had fallen on 1 June. The salamanders were found in a 1.2 m^2 drip zone at the base of the rockface (Photo. 9b) 22 m from the eastern extent of the seepage area. One immature (1.8 cm SVL) salamander was preserved.

Population: We searched this area twice in 1986 and were unable to find salamanders. This fact, plus the few salamanders we were able to find on 4 June, may indicate a small-medium population here. The best local microhabitat may be the small rockpile in which we found the salamanders. We also searched in six seepages on the old highway up to one mile west of Troy 3.

Troy 4 (historical site).

Kootenai National Forest in Lincoln Co. Kootenai River dranage. Salamanders searched for around a northfacing, cobbly seepage due east of Troy. Elevation is 2100 ft. Site is on the south side of U.S. Highway 2, 8.3 miles from the Lake Creek bridge in Troy. U.S.G.S. quad: Scenery Mountain 7.5 min. In sect. 16; T31N, R31W. See Map 2.

History: Dumas collected a single salamander here while "looking for alligator lizards about 20 years ago". Brodie's (1970) crediting 17 salamanders to Dumas' collection is an error (P. C. Dumas, pers. comm.).

Site description (no photographs): This is a heavily flowing spring. Water emerges from under a bed of soil impacted cobbles and deadfall on a 10^{o} slope, 15 m south of the highway. It forms a 35 m^2 pool and is culverted beneath the highway and a rail easement to the Kootenai River 100 m away.

The surrounding habitat type is THPL/CLUN grading into PSME/SYAL and SCREE. Exposed Belt rock cliffs rise 50 m to the east. There is an ~80% overstorey of Thuja plicata, Betula papyrifera, Pseudotsuga menziesii, and Abies grandis. Prominent shrubs include Cornus stolonifera, Rosa sp., Symphocarpos alba, and Ribes sp. Ground cover is thick bryophyte mat with Rubus parviflora.

Observations: We unsuccessfully searched here twice, once during the day on 4 June and once at night on 5 June. At the start of the day search, which included areas south and north of the highway, the air temp. was $24.4^{o}C$, the temp. of emergent water was $7.2^{o}C$, and the sky was clear. It had last rained on

1 June. During the night search of the area south of the highway, air temp. was 18.8°C, emergent water temp. was 6.7°C, and the sky was clear. Local daytime air temp. was 27°C.

Population: This is likely a small population.

Troy 5 (new site).

Kootenai National Forest in Lincoln Co. Kootenai River drainage. Salamanders found along a NNW running creek due east of Troy. Elevation is 2100 ft. Site is on U.S. Highway 2, 11.5 miles from the Lake Creek bridge (Photo. 10a). U.S.G.S. quad: Scenery Mountain 7.5 min. In sect. 23; T31N, R31W. 48°, 26′, 20" lat., 115°, 38′ 50" long. See Map 2.

Site description: This is a section of Rocky stream with trickling, cascading flow on a 25° bed. The topographic map shows the creek extending ~1.5 miles into the mountains south of the highway. Water is culverted beneath the highway and enters the Kootenai River 15 m to the north.

Slopes of 30° rise from the creek's margins. The habitat type is THPL/CLUN grading into PSME/SYAL. There is a 70-80% overstorey of Thuja plicata, Pseudotsuga memziesii, Betula papyrifera, and Larix occidentalis. Prominent shrubs include Symphocarpos alba, Acer glabrum, Rosa sp., and Ribes sp. Ground cover includes bryophyte mat, Equisetum arvense, Rubus parviflora, and various grasses and forbs. The creekbed comprises a ~2 m wide damp area filled with bryophyte covered boulders and deadfall (Photo. 10b). There are no freestone reaches. Fractured Belt rock is exposed at numerous places along the creek's edge.

Observations: On the night of 3 June we counted six salamanders along 30 m of creek south of the highway. We preserved one immature (2.2 cm SVL) salamander. Air temp. was 17.2°C, water temp. was 7.8°C, and the sky was clear. High daytime air temp. on 3 June was ~25°C and it had last rained on 1 June.

Population: In the area of the highway, surface density indicates a small-medium sized population. This is probably part of a large, well dispersed population along the creek's length. Except on rainy nights, the population is probably restricted to the damp area at creekside.

North Troy 1 (new site).

Burlington Northern and other private land, Lincoln Co. Kootenai River drainage. Salamander found on bank of an unnamed, NE flowing creek due NW of Troy. Elevation is 2040 ft. Site is 20 m upstream from South Side Road, Forest Route 4402, 1.1 miles from its junction with U.S. Highway 2, and 3 miles from Troy city limits (Photo. 11a). U.S.G.S. quad: Troy 7.5 min. In sect. 34; T32N, R34W. 48°, 28′, 07" lat., 115°, 55′, 29" long. See map. 4.

Site Description: This is a small, cobbly stream with numerous freestone reaches and some small cascades. At the site of capture (Photo. 11b) it flows along a 15° bed. It enters the Kootenai River ~500 m to the NNW. The topographic map shows the creek extending ~0.5 miles up the flank of a peak to the SW. A logging operation, begun in the spring of 1987, has bared the creek's upper drainage. Water flow decreased by ~30% between 31 May and 20 August.

The 30-40° slopes rising from the creek's edge are forested in the THPL/CLUN habitat type. There is a 60-80% overstorey of Thuja plicata, Larix occidentalis, Pseudotsuga menziesii, and Tsuga heterophylla. Few shrubs grow in open areas around the creek. These include Acer glabrum, Betula sp., Rosa sp., and Ribes sp. Groundcover is primarily bryophyte mat with a few forbs. Bryophyte covers cobbles and deadfall in the creek. There are large areas of exposed Belt rockface (Photo. 11b) nearby.

Observations: We found and preserved one adult female (4.4 cm SVL) salamander during a one hour search on 31 May. We searched ~100 m of creekside. Air temp.

was 8.9°C, water temp. was 7.8°C, and light rain was falling from a completely overcast sky.

Population: We searched this creek several times in 1985 and 1986 without finding any salamanders. This, plus our inability to find more than one salamander here on 31 May, indicate the local population is small. This may be part of a larger population along the creek's length. The degree to which this microhabitat has been damaged by logging is not known as of this writing. The area outside of the creek's edge seems too dry to support plethodontids.

Keeler Creek (historic site).

Kootenai National Forest in Lincoln Co. Kootenai River drainage. Salamanders searched for on the West Fork Keeler Creek due SSW of Troy. Elevation is 3100 ft. Site is on Forest Route 473, 7.0 miles from its junction with Lake Creek Road. U.S.G.S. quad: Mt. Pend Orielle 15 min. In sect. 30; T30N, R24W. 49°, 29′, 45" lat., 116°, 00′, 30" long. See Map 3.

History: According to Nature Conservancy records, D. Gay reported finding one salamander near a bridge on Keeler Creek in 1984. No specimen was collected.

Site description: We searched in the vicinity of the only bridge on the West Fork Keeler Creek (Photo. 12). The creek is a freestone stream on a flat floodplain. Forest Service personnel informed us that the floodplain resulted from clearcuts (part of a Spruce Budworm control program) in the surrounding mountains ~30 years ago. Stream level dropped by 80% between 19 May and 20 August.

The habitat can best be described as Bottomland Hardwood (Pfister et al., 1977). The few conifers in the area include Pseudotsuga menziesii, Thuja plicata, Tsuga heterophylla, and Pinus monticola. Judging from stands further downstream, the area may have at one time been dominated by Thuja plicata. At present there is a scant overstorey at the bridge that comprises Populus

trichocarpa, Salix discolor, Salix amygdaloides, Betula papyrifera, Acer glabrum, and immature conifers. Immediately NW of the bridge is a beaver pond. The ground in the area is boggy, with a cover of grasses and forbs or otherwise bare, imbedded cobbles. There is some bryophyte mat with Equisetum arvense in boggy areas on the creek's perimeter. These areas occur in the runoff from the beaver pond.

Observations: We unsuccessfully day-searched both sides of the creek, ~100 m north and south of the bridge on 19 May and 31 May. On 19 May air temp. was 21.6°C, water temp. was 6.7°C and the sky was 50% overcast. It had last rained on the preceeding day. On 31 May, air temp. was 7.8°C, water temp. was 6.1°C, and rain was falling from a completely overcast sky. On 19 May we also searched a portion of the floodplain ~1.8 miles downstream from the bridge. This is the area indicated by the Nature Conservancy Element Occurrence record.

Population: This floodplain area is unique among the habitat types in which we have found the Coeur d'Alene Salamander. Any population must be small. We suspect the animal Gay found was either a Coeur d'Alene Salamander, somehow washed down from suitable microhabitat upstream, or an Ambystoma macrodactylum.

Surprise Gulch (new site).

Kootenai National Forest in Lincoln Co. Kootenai River drainage. Salamanders found at roadside along a SW flowing creek, 6.5 miles due east of Troy. Elevation is 3580 ft. Site is located on Forest Route 4445, four miles from its southern junction with Forest Route 331 (Photo. 13a, 13b). U.S.G.S. quad: Kootenai Falls 7.5 min. In sect. 3; T31N, R33W. 48° 28′ 33" lat., 115°, 48′, 17" long. See map 1.

Site description: This is a trickling, cascading stream that flows down a 25° bed. The topographic map shows the creek extending ~ one mile up from the roadway, along the SW flank of King Mountain. A flow reduction of 10% occurred

between 19 May and 20 August. The 25-30^{o} slopes rising from creekside are forested in PSME/PHMA grading into SCREE. Fractured Belt rock is exposed along the road. Prominent trees include Pseudotsuga menziesii, Larix occidentalis, and Pinus ponderosa. Shrubs in the area include Physocarpus malvaceus, Rosa sp., and Holodiscus discolor. Shrubs provide most of the 20-60% overstorey on the creek. These include Acer glabrum, Betula sp., Cornus stolonifera, Salix discolor, and immature conifers. Above the road, the creekbed is muddy with grassy bryophyte mat covering imbedded cobbles (Photo. 13c). Below the road there is similar microhabitat except near the creek's culvert, which spills water over a deep riprap partially covered with bryophyte mat (Photo. 13d).

Observations: We found salamanders here during day searches on 19 May and 31 May. On 19 May, air temp. was 20^{o}C, water temp. was 6.7^{o}C, and the sky was 50% overcast. The last rain had fallen on 17 May. We searched for 40 minutes along 50 m of creek above the roadway, where we found one salamander, and in the splashzone below the culvert, where we found three. On 31 May, air temp. was 6.1^{o}C, water temp. was 6.1^{o}C, and snow was falling from a completely overcast sky. We found four salamanders below the culvert in a 10 minute search. One of these, an immature (2.2 cm SVL), was preserved.

Population: Salamanders are especially easy to find below the roadway. We were limited in our ability to find salamanders here only by our inability to move enough rock. There may be a medium-large population along the creek wherever such splashzones occur. We unsuccessfully searched an area of the creek on Forest Route 4445, ~0.5 mile downstream from the capture site. Stream habitat here is similar to that upstream except for a more dense growth of Rubus parviflora. The surrounding hills are fairly dry. Salamanders are thus probably restricted to the creek except during rainy periods (also see Sect. R3; 14, 15).

Yaak Falls (new site).

Kootenai National Forest in Lincoln Co. Kootenai River drainage. Salamanders found in two rocky seepages on the NW bank of the Yaak River ~12 miles due north of Troy. Elevation is 2400 ft. Site is off State Highway 508, 6.9 miles from its junction with U.S. Highway 2. U.S.G.S. quad: Newton Mountain 7.5 min. In Sect. 4; T33N, R33W. 48°, 38′, 49" lat., 115°, 53′, 5" long. See Map 5.

Site description: Two lightly flowing seepages, ~15 m apart, are near the river's edge ~50 m downstream from Yaak Falls (Photo. 14a). Both seepages are at the base of a ~6 m, fractured Belt rockface. The downstream seepage comprises a 6 m^2 damp area on vertical rockface and a small dripzone atop a boulder colluvium (Photo. 14b). The colluvium slopes to the river 10 m away. The upstream site comprises a ~10 m^2 vertical damp area and dripzone in an alcoved section of rockface. This is also atop a boulder colluvium, 6 m from the river (Photo. 14c).

Below Yaak Falls, the river flows through a rocky gorge of vertical Belt rock. Surrounding slopes are forested in PMSE/SYAL grading into THPL/CLUN (especially on the east side of the river). Trees in the area include Thuja plicata, Pseudotsuga menziesii, Pinus contorta, Pinus ponderosa, and Populus trichocarpa. Prominent shrubs include Acer glabrum, Symphocarpos alba, Ribes sp., Rosa sp., and Salix sp. Ground cover is made up of bryophyte mat with grasses and forbs. The downstream seepage has a scant shrub overstorey, and bryophyte mat covers less than 10% of the rock surface. Atop the colluvium is a layer of soil, small rock fragments, and plant litter. The upstream seepage is similar, but with a 20% overstorey provided by one Populus trichocarpa, and some Acer glabrum.

Observations: We found two salamanders in each of the seepage areas on 1 June. We searched for ~20 minutes and were hampered by the large size of rock

fragments in the seepages. Air temp. was 10.6°C, emergent water temp. was 7.2°C, and rain was falling from a completely overcast sky. One adult female (5.4 cm SVL), from the downstream site, was preserved.

Population: Salamanders were easy to find in the small areas we were able to search and much damp area probably exists in the large interstices of the colluvia. We therefore think this population may be medium-large. Except during rainy periods the salamanders are probably restricted to the seepage areas. We have also searched seepages on the other side of the river (at night in 1985) and J. E. Lynch (pers. comm.) searched the area around the falls and the gorge downstream without finding salamanders. This population thus seems isolated to the area of capture (also see Sect. R3; 5,6,7).

Big Hoodoo Mountain (historic site).

Kootenai National Forest in Lincoln Co. Kootenai River drainage. Salamanders searched for along three unnamed creeks on the NNW side of Big Hoodoo Mountain ~10.5 miles due south of Libby. Elevation of historic site at roadside is 3060 ft. Historic site is on Forest Route 278, 4.4 miles from its junction with U.S. Highway 2 (Photo. 15a). U.S.G.S. quad: Cable Mountain 7.5 min. In sect. 34; T29N, R31W. 48°, 14′, 8" lat., 115°, 33′, 14" long. See Map 6.

History: One salamander was collected here by E. K. Teberg in 1962 (Teberg, 1964). Both P. C. Dumas and J. E. Lynch (pers. comm.) have searched this area without success.

Site description: We searched three creeks, two of which have substantial clearcuts in their upper drainages. At one time, all were presumably similar. Our site description centers around the undisturbed section of the creek in which Teberg made his salamander collection. This is a trickling, cascading stream that flows down a 30-35° slope. We noted a ~20% reduction in flow

between 17 May and 20 August. Slopes of 25-40^{o} rise from the creek's margins. They are forested in TSHE/CLUN grading into ABGR/CLUN upland. There is a 70-80% overstorey of Tsuga heterophylla, Thuja plicata, Pseudotsuga menziesii, and Abies grandis. Near the road is a dense cover of Cornus stolonifera, Acer glabrum, Betula sp., Populus trichocarpa, and immature conifers. Prominent shrubs away from the roadway include Ribes sp. and Rosa sp. Ground cover adjacent to the creek, and extending well up the creekside slopes, is primarily bryophyte mat with few forbs. Equisetum arvense grows close to the creek. Exposed bedrock in the area is Belt mudstone. Below the road, the stream steepens and cascades down several well fractured rockfaces. There is considerable deadfall in the creekbed. This and much of the creekbed rock is covered by bryophyte mat (Photo. 15b). The creek drains into Cherry Creek, a freestone stream, ~130 m below the roadway.

At the historic site, a recent clearcut extends along 70 m of the creek from where it enters Cherry Creek. Above the road the slopes are completely forested. ← Not anymore. 0.8 mile (by Forest Route 278) SW of the historic site is another, similar creek. Virtually all of its drainage uphill from the road is exposed by a clearcut. Another creek is 1.4 miles SW of the historic site. This creek is forested to ~70 m uphill from the road, but its upper drainage is also exposed by a clearcut.

Observations: We unsuccessfully searched here three times. On the night of 17 May we searched ~70 m above the road at each creek. We also searched the historic stream along its entire length between Cherry Creek and the road, as well as a boggy seepage at roadside. Air temp. at the beginning of the search was 20.1^{o}C. Creek water temperatures were as follows: historic site, 8.3^{o}C; clearcut site, 11.1^{o}C; partly clearcut site, 10^{o}C. The sky was completely overcast. The high local daytime temp. was 22.2^{o}C. We found no salamanders but encountered three Ascaphus truei at the historic site below the road.

On the night of 18 May we searched the same areas as on 17 May, plus two seepages in the upper drainages of the two clearcut sites. Local high air temp. on 18 May was 20.6°C. Air temp. at the start of the search was 15°C and the sky was 20% overcast. Water temperatures at the three creeks were as follows: historic site, 8.3°C; other sites 8.9°C. Water temp. in the seepages was 6.7°C. We found no salamanders, but found two Ascaphus truei at the historic site, one above and one below the road; and one Ascaphus truei at the partly clearcut site.

On the night of 4 June we search the historic site and the partly clearcut site, each ~70 m above the roadway. High air temp. during the day was 31.7°C and the last rainfall had occurred on 1 June. Air temp. at the start of the search was 21.6°C, water temp. in both streams was 8.9°c, and the sky was clear. No salamanders were found.

Population: Despite the pristine conditions and decent looking microhabitat in the historic site we found no salamanders. It is possible that the Coeur d'Alene Salamander has never occurred at this locality, at least in historical time.

Koocanusa 1 (new site).

Kootenai National Forest in Lincoln Co. Kootenai River drainage. Salamanders found in a rocky seepage on a NE facing roadcut ~19 miles due NE of Libby. Elevation is 2800 ft. Site is on the SW side of Forest Route 228 (Photo. 16a) 21.7 miles from its southern intersection with State Highway 37. U.S.G.S. quad: Volcour Gulch 7.5 min. In sect. 29; T33N, R28W. 48°, 35′, 21" lat., 115°, 14′, 56" long. See Map 7.

Site description: There are two lightly flowing seepages here, separated by 12 m at roadside. The more southern of the two involves a 6 m high vertical wall of well fractured Belt rock and a 20 m long, 40° cobbly slope above. Along the

base of the rockface rubble has accumulated. Emergent water forms a damp area of ~70 m^2. The more northern of the two is a 40 m long, 2 m wide strip of wet cobbles extending up the 40° roadcut slope. The upper extent of both seepages is below soil level at the top of the roadcut. Water from both is culverted beneath the roadway and percolates into riprap. Flow decreased ~30° during the summer.

The 30° slopes above the roadcut are forested in PSME/PHMA grading into THPL/CLUN. Dominant trees include Larix occidentalis, Thuja plicata, and Pseudotsuga menziesii. There is no tree or shrub overstorey to these seepages. Prominent shrubs on the roadcut includes immature conifers, Acer glabrum, Cornus stolonifera, Betula sp., and Salix sp. Outside the seepages there is a scant ground cover of grasses and forbs. Both seepages have a ~50% cover of bryophyte mat (Photo. 16b). Cobbles in the northern seepage are well impacted in mud.
Observations: We found three immature salamanders at the southern seepage during the first 15 minutes of a one hour day search on 8 June. The air temp. was 14.4°C, water temp. was 8.5°C, and rain was falling from completely overcast skies. All animals were found in the loose rock below the rockface. One individual (2.6 cm SVL) was preserved. No salamanders were found in the northern seepage or in the damp riprap below the road.
Population: Based on the few salamanders we found, and on the large area of fractured rock, we estimate the population here to be small-medium sized. The best microhabitat is in the southern seepage. Surrounding areas are too dry to support plethodontids.

Koocanusa 2a, 2b, 2c (new sites).

Kootenai National Forest in Lincoln Co. Kootenai River drainage. Salamanders found in rocky seepages and along an unnamed creek, on ~800 m of roadway ~20 miles due NE of Libby. Elevation is 2680 ft. Sites are on the SW

side of Forest Route 228; mileages given are from this road's southern junction with State Highway 37. U.S.G.S. quad: Inch Mountain 7.5 min. In sect. 11; T33N, R29W. Centered at 48°, 38′, 05" lat., 115°, 08′, 25" long. See Map 8. General description: All sites are associated with Belt mudstone. The 30° slopes above the sites are forested in PSME/PHMA grading into THPL/CLUN. Dominant trees include Larix occidentalis, Thuja plicata, and Pseudotsuga menziesii. Salamanders were collected from these sites on 8 June while the sky was completely overcast and rain was falling. Because Coeur d'Alene Salamanders may wander during rainy weather, the isolated wet areas here may support a single large population.

Koocanusa 2a.

This site is 26.1 miles from Highway 37 (Photo. 17a).

Site description: This is a very lightly flowing seepage comprising a well fractured, 5 m high vertical rockface at the base of a 20 m long, 40° slope. Rock fragments have accumulated at the base of the rockface. The upper extent of the seepage is below soil level at the top of the roadcut. On 8 June there was a ~50 m^2 damp area. This had decreased by 90% on 20 August. A culvert is in place beneath the roadway but during the 8 June visit water went underground before reaching it. There is little plant growth around the seepage and no overstorey. Local shrubs include Cornus stolonifera, Betula sp., and Salix sp. Bryophyte mat with grasses covers less than 5% of the seepage surface (Photo. 17b).

Observations: We found and preserved one adult female (4.6 cm SVL) salamander which we removed from a fracture in the rockface. Air temp. was 14.4°C and water temp. was 13.0°C. We collected the animal in the first 10 minutes of a 20 minute search. We also retrieved a neonatal salamander from the digestive tract of an immature Thamnophis sirtalis parietalis.

Population: The salamanders here may be part of the population at Koocanusa 2b. The dry surrounding areas, and the impermanence of the seepage make this poor plethodontid habitat.

Koocanusa 2b.

This site is 26.4 miles from Highway 37 (Photo. 18a).

Site description: This is a lightly flowing, well fractured seepage of ~11 m^2. It is on a 30^o roadcut, 20 m below the forest. The wet area includes a short rubble pile atop a 3 m high vertical rockface at the bottom of a dry 5 m cliff. A 1 m wide boggy area extends along 5 m of the foot of the rockface. Water percolates below the roadway. This seepage, described as it appeared on 20 August, represents ~10% of the damp area we observed on 8 June, when the entire roadcut was damp. There is a scant overstorey of shrubs including Salix mackenzieani and Betula sp. Ground cover includes bryophyte mat with mixed grasses and forbs. The seepage area is ~80% bare rock (Photo 18b).

Observations: We found one adult and one immature salamander in the first 15 minutes of a 40 minute search. Both were in the rubble at the base of the rockface. Air temp. was 13.9^oC and water temp. was 15.0^oC. The immature (2.2 cm SVL) was preserved.

Population: This may be a small-medium sized population. As with Koocanusa 1, there is a large fracture zone which we could not search. Except during rainy periods, salamanders are likely restricted to the damp areas of this site.

Koocanusa 2c.

This is an unnamed NE flowing creek 26.6 miles from Highway 37 (Photo. 19a). It has a trickling, cascading flow down a 30^o bed at roadside. The topographic map shows it extending ~1 mile into the mountains SW of the highway. The creekbed is culverted beneath the highway but goes underground before reaching the culvert. There was a ~30% flow reduction between 8 June and 20

August. The 40° slopes rising from the creek's margins have exposed Belt rock and are forested in THPL/CLUN locally. Thuja plicata, Larix occidentalis, and Pseudotsuga menziesii provide an overstorey of 70-80%. Prominent shrubs include Betula sp., Cornus stolonifera, Ribes sp., and Rubus parviflora. The creek involves a 2 m wide damp area of deadfall and cobbles covered in bryophyte mat (Photo. 19b).

Observations: We found one adult and one immature in a 15 minute search. Air temp. was 14.4°C and water temp. was 7.0°C. The immature salamander (1.4 cm SVL) was preserved.

Population: The extensive damp area here plus the speed with which we were able to find salamanders, may indicate a medium-large population dispersed along the creek. The surrounding forest seems too dry to support plethodontids.

Koocanusa 3 (new site).

Kootenai National Forest in Lincoln Co. Kootenai River drainage. Salamanders found in a NE flowing creek ~20 miles due NE of Libby. Elevation is 2680 ft. Site is on the SW side of Forest Route 228, 27.4 miles from its southern junction with State Highway 37 (Photo. 20a). U.S.G.S. quad: Inch Mountain 7.5 min. In sect. 10: T33N, R29W. 48°, 38′, 33" lat., 115°, 19′, 32" long. See Map 8.

Site description: The geography, habitat type, and microhabitat here are almost identical to those described for Koocanusa 2c. There was a greater reduction in water flow at this site (down by 60%) between 8 June and 20 August and there is less bryophyte growth near the roadway (Photo. 20b).

Observations: We found two immature salamanders here in a 15 min. search. One (1.5 cm SVL) was preserved. Air temp. was 14.4°C and water temperature was 7.5°C.

Population: As with Koocanusa 2c, we estimate this population to be medium-large.

The area around the Koocanusa sites needs survey away from the roadway. This area probably supports much Coeur d'Alene Salamander microhabitat (also see Sect. R3; 26, 27, 28).

Noxon (historical site).

BLM(?) land in Sanders County. Clark Fork River drainage. Salamanders found along an unnamed, NW flowing creek due WNW of Noxon. Elevation is 2240 ft. The site is located off the Heron-Noxon road 1.9 miles from its junction with Forest Route 149 in Noxon (Photo. 12a). U.S.G.S. quad: Smeads Bench 7.5 min. In sect. 14; T26N, R33W. 48°, 00′, 17" lat., 115°, 49′, 9" long. See Map 9.

History: We were first informed of this site by J. E. Lynch. It is unclear who discovered the population. A specimen is credited by Brodie (1970) to the collection of E. K. Teberg, but Teberg (pers. comm.) does not remember ever collecting animals here.

Site description: This is a cascading, trickling section of a creek (not indicated on the topographic map) on the SE flank of Loveland Peak (Photo. 21b). Water flow is light and the stream is likely perennial: a flow reduction of only 15% occurred between 16 May and 20 August. The creek emerges from a spring at the base of a 30° slope due south of where it crosses the Heron-Noxon road. It meanders NW on a boggy bench sloped 10° and is ponded behind a small wooden dam, 300 m from its source. Below the dam the creek plunges down a 30° bed to the road, 50 m away. It is culverted under the road, then nearly parallels the road at 15-20° for 60 m, where it cuts due north and drops into a trough in the floodzone of the Clark Fork River. Slopes rising from the creek's margins vary

from 10-30°. To the west of the creek, along its entire length, are cliffs of fractured Belt mudstone. These vary in distance from the creek: above the dam the distance is ~20 m, below the dam, 5-20 m.

The habitat type is THPL/OPHO. There is a 60-70% overstorey of trees including Tsuga heterophylla, Thuja plicata; and some Pseudotsuga menziesii. Undergrowth is scant except at roadside. It includes Alnus rubra, Betula sp., Rubus parviflora, and Oplopanax horridum. Ground cover at creekside is bryophyte mat. Above the dam the creek flows on a mud and gravel bed with few cascades. Below the dam there are many cascades as the water drops over boulders and exposed slabs of mudstone (Photo. 21c), forming a 2 m wide damp zone. There is considerable deadfall over the entire length of the creek. This and the exposed rock are covered in bryophyte mat.

Observations: We first visited the site on 16 May and performed a day search along the cascade section of the creek between the road and the dam. Air temp. was 16.1°C, water temp. was 7.2°C, and the sky was clear. The last rain had fallen on 15 May. We found one immature salamander in a 15 minute search. We performed two night searches here on 20 May and 30 May. During these we searched the cascade area between the road and dam, and 60 m of creek above the dam. We didn't search the creek below the road because it is on fenced, private land.

On 20 May, the air temp. was 7.2°C, the water temp. was 6.7°C and the sky was completely overcast. High air temp. on the preceeding day was 13.3°C and the last rain had fallen on 15 May. We found five salamanders in the cascade area and none above the dam. On 30 May the air temp. was 10.6°C, water temp. was 7.2°C, and rain was falling from a completely overcast sky. Local daytime temperature on 30 May had approached 21°C. We observed two salamanders in the cascade area and none above the dam. while preparing to leave the site, we noticed a salamander on the roadway. We then searched the road for 100 m on

both sides of its crossing at the creek. We found two more salamanders on the roadway, and three in talus at the base of an exposed cliff near the roadside. All of the six salamanders we found along the easement were within 30 m of the portion of creek that parallels the road. On the 20 May visit, we found an Ambystoma macrodactylum in the area of creek between the dam and road.

Population: This is likely a medium-large population. The best microhabitat is that associated with the cascading portion of the stream and except during rainy periods, the population is likely restricted to this area. We searched all roads surrounding Loveland Peak and did not find any damp areas that might support other salamander populations. Such populations may be found at higher elevations on the mountain, where hardwood stands indicate springs (also see R3; 39, 41, 42, 43).

Thompson River sites 1a, 1b; Priscilla Gulch and Barktable Creek.

Private land and Lolo National Forest in Sanders Co. Clark Fork River drainage. Salamanders found in rocky seepages and small creeks along the Thompson River, ~10 miles ENE of Thompson Falls.

History: Nature Conservency records indicate that the salamander was discovered here by L. S. Thompson on 6 June 1986, probably at the site we have named Thompson River 1b. The other three locations were discovered during our study.

General description: Salamanders in all sites were found near the Thompson River in an area of steep slopes and exposed cliffs of Belt mudstone (Photo. 22a). On the NW side of the river the habitat type is mostly PSME/SYAL grading into SCREE. On the SE side there are also stands of THPL/CLUN (Photo. 22b). There are two roads paralleling the river, one along each bank. Sites 1a and 1b are on the SE bank and are ~300 m apart. Since Coeur d'Alene Salamanders may wander extensively during rainy periods, these two sites may comprise a single population.

Thompson River 1a (new site).

Lolo National Forest. Salamanders found in a series of NW facing rocky seepages on a roadcut. Site is on the private East Thompson River Road, beginning 10.3 miles from its junction with State Highway 200. Elevation is 2750 ft. U.S.G.S. quad: Calico Creek 7.5 min. In sect. 18; T22N, R27W, 47°, 40′, 10" lat., 115°, 00′, 19" long. See Map 10.

Site description: This site comprises two seepage areas cut into a 15° slope. Water in both flows lightly from near vertical 5-6 m high cliffs of fractured Belt rock. Neither seepage is culverted to the river, 4 m below on the other side of the road. A culvert pipe is in place, apparently to catch spring runoff. Between 21 May and 22 August we noted no flow reduction in the seepages. The first (going north) seepage encompasses ~10 M^2 of damp area (Photo. 23a). It is separated from the second seepage by 50 m. The second seepage involves ~300 m^2 of damp area extending along 60 m of roadway (Photo. 23b). Trees on the slopes above include Larix occidentalis, Pseudotsuga menziesii, and Thuja plicata. Both seepages support the same plants. There is a 50-70% shrub overstorey of Betula sp., Cornus stolonifera, Ribes sp., and immature conifers. The ground is densely covered in grasses, Equisetum arvense, and some bryophyte mat. There is little exposed bedrock in the seepages: most rock is covered by soil.

Observations: We performed night counts here on 21 May and 14 June. At the start of the 21 May count air temp. was 4.4°C, emergent water temp. was 5.0°C, and the sky was completely overcast. Local daytime air temp. on 21 May was ~16°C, and rain had fallen that evening. We found 2 salamanders, one in each of the two seepages. During the 14 June count air temp. was 11.1°C, water temp. was 7.2°C, and the sky was clear. Air temp. the preceeding day was ~32°C and

the last rain had fallen on 9 June. We found two salamanders, both in the more southern of the two seepages.

Population: It is difficult to assess the population here. The climate on neither visit was optimal for salamander observations, being too cold on 21 May and (possibly) too desiccating on 14 June. Also, the dense ground cover at this site makes it difficult to find salamanders. We feel, however, that the population here is small, given the extremely few salamanders we were able to observe. Except during rainy weather, salamanders are likely restricted to the seepages since surrounding areas seem too dry to support plethodontids (also see R3; 54, 55).

Thompson River 1b (historic site).

Lolo National Forest. Salamanders found in a NW facing rocky seepage. Site is in a roadcut on the private East Thompson River Road, 10.5 miles from its junction with State Highway 200. Elevation is 2750 ft. U.S.G.S. quad: Calico Creek 7.5 min. In sect. 18; T22N, R27W. 47°, 40′, 20" lat., 115°, 6′, 05" long. See Map 10.

Site description: This is a heavily flowing seepage of ~50 m^2 on a 5.5 m high vertical cut into a 15° slope. Falling water forms a 6 m long dripzone at the base of the rockface that extends 1 m horizontally. It is then culverted beneath the road, over a riprap, and into the river 6 m below. We noted little flow reduction between 21 May and 22 August.

The slopes above the seepage are forested in Larix occidentalis, Thuja plicata, and Pseudotsuga menziesii. There is a 30% overstorey of Thuja plicata, Betula sp., Ribes sp., and Physocarpus malvaceus. Ground cover in the seepage is mostly bryophyte mat and little of the underlying rock is exposed. Other ground cover includes grasses, Equisetum arvense, and Centauria repens (Photo. 24).

Observations: We performed night counts here on 21 May and 14 June. During the 21 May count, air temp. was 5.6°C, water temp. was 6.8°C and the sky was completely overcast. Rain had fallen earlier in the evening and daytime temp. was ~16°C. We found one salamander and one Ascaphus truei on scree at the base of the rockface. At the start of the 14 June count air temp. was 12.8°C, water temp. was 9°C, and the sky was clear. Daytime air temp. was ~32°C and the last rain had fallen on 8 June. We found three salamanders, all climbing bryophyte.
Population: The population here is likely small. Climate during our visits was not optimal, however: see Thompson River 1a (also see R3; 52).

Priscilla Gulch (new site).

Lolo National Forest. Salamanders found along a small SE flowing creek on Forest Route 56, 9 miles from its junction with U.S. Highway 200 (Photo. 25a). Elevation is 2660 ft. U.S.G.S. quad: Priscilla Peak 7.5 min. In sect. 13 and 14; T22N, R28W. 47°, 39′, 37" lat., 115°, 08′, 11" long. See Map 11.
Site description: This is a section of a rocky creek with trickling, cascading flow down a 20° slope. The topographic map shows the creek extending ~1 mile into mountains NW of F.R. 56. Water is culverted beneath the roadway, then flows, via a straight channel, into the river 30 m away. We noted a 30% reduction in stream flow between 21 May and 22 August.

Slopes of 30-60°, with much exposed Belt mudstone, rise from the creek's margins. These are forested in Pseudotsuga menziesii, Larix occidentalis, and Pinus ponderosa. There is a 60-70% overstorey at the creek, of trees and undergrowth including Acer glabrum, Betula sp., Ribes sp., Symphocarpos alba, and Rubus parviflora. Ground cover is mostly bryophyte mat with mixed grasses and forbs. The creek bed is filled with cobbles and deadfall. Bryophyte mat covers these and most other surfaces in the 3 m wide damp area of the creek (Photo. 25b).

Observations: We performed night counts here on 21 May and 14 June. During both these counts we searched 30 m of creek above the road and the 30 m going into the river below the road. At the start of the 21 May count air temp. was 9.4°C, water temp. was 6.1°C, and rain was falling from a completely overcast sky. Local daytime air temp. was ~16°C, and rain was falling from a completely overcast sky. Local daytime air temp. was ~16°C. We found two salamanders, both on bryophyte in the section of creek above the roadway. During the 14 June count air temp. was 21.1°C, water temp. was 10.6°C and the sky was completely clear. Air temp. during the day was ~32°C and the last rain had fallen on 8 June. We found one immature salamander (3.1 cm SVL), which we collected and preserved, above the roadway.

Population: This is likely a small-medium sized population. The best microhabitat is in cascade areas such as the one we searched above the road. Surrounding areas seem too dry to support plethodontids (also see R3;53).

Barktable Creek (new site).

Champion International land. Salamanders found along a small, SE flowing creek on the NW side of Forest Route 56, 11.5 miles from its intersection with State Highway 200 (Photo. 26a). Elevation is 2800 ft. U.S.G.S. quad: Calico Creek 7.5 min. In sect. 7; T22N, R27W. 47°, 40′, 31" lat., 115°, 05′, 48" long. See Map 10.

Site description: This site is very similar to the Priscilla Gulch site. The topographic map shows Barkstable Creek extending twice as far into the mountains NW of the river as Priscilla Gulch. The slopes rising from Barktable Creek's margins are less steep, sloping 40° at most. There is an old burn or logged clearing along a portion of the creek's northern margin, 100 m above the road. The microenvironment of the creek is otherwise the same as that already

described for Priscilla Gulch (Photo. 26b). Below the road, Barktable Creek slopes 10° and flows, with few cascades, to the river 100 m away.

Observations: We searched 30 m of creek above and below the road during night counts on 21 May and 14 June. Air temp. during the 21 May search was 8.3°C, water temp. was 6.1°C, and rain was falling from an overcast sky. Local daytime air temp. had been ~16°C. We found one salamander at creekside above the road. During the 14 June count air temp. was 18.3°C, water temp. was 10°C, and the sky was clear. Air temp. during the day had been ~32°C and the last rain had fallen on 8 June. We found two salamanders at creekside above the road. An immature (2.4 cm SVL) was preserved.

Population: This is likely a small-medium population. Considering the distribution of the salamanders we observed, the best microhabitat is likely in cascade areas similar to that immediately above the roadway. The population may be dispersed along Barkstable Creek wherever such microhabitat exists. The surrounding areas appear too dry to support plethodontids (also see R3; 51).

Sims Creek (new site).

Kaniksu National Forest in Sanders Co. Clark Fork River drainage. Salamanders found in a small spring on a SW facing roadcut ~18 miles due north of Thompson Falls. Elevation is 3300 ft. Site is on the north side of Forest Route 154, 8.8 miles from its junction with Blue Slide Road (Photo. 27a).

U.S.G.S. quad: Seven Point Mountain 7.5 min. In sect. 2; T24N, R30W. 47°, 52′, 14" lat., 115°, 24′, 07" long. See Map 12.

Site description: The roadcut breaks a 15° slope, 10 m above the floodplain of the Vermillion River. Nearby slopes are forested in ABGR/CLUN that grades into THPL/CLUN and PSME/SYAL. Prominent trees include Pseudotsuga menziesii, Abies grandis, and Larix occidentalis. The spring is at the base of the (38°) roadcut, which is well exposed to the south. The roadcut extends upward from

the spring ~15 m to the edge of the forest. Three immature Populus trichocarpa provide scant overstorey to the spring (Photo. 27b). Except for a trickle of water running along the road, little dampness is apparent. Water emerges from a point source, then flows into a shallow pool 120 m to the west. From here it is channeled to the river. There was no apparent reduction in flow between 21 May and 21 August. There is very scant bryophyte mat over the rubble beneath the Populus. There is little soil and scant growth of grasses and forbs.

Observations: We visited this site and performed a day count on 21 May. Air temp. was 9.4°C, water temp. was 5.0°C, and the sky was 75% overcast. Local air temp. on the preceeding night probably dropped below 4°C. The last rain had fallen on 17 May. We found two salamanders in the first 10 minutes of a one hour search. Both were found at the spring source and one, an immature (3.1 cm SVL), was preserved. Included in our search were the runoff of the spring, a boggy area around the pooled runoff, and the banks of Sims Creek, a freestone stream 160 m to the west.

Population: The population around the collection site is small: there is not much damp area locally. Our ability to find salamanders may have been hampered by cold weather on the preceeding night (also see R3; 45, 46).

Cougar Gulch (new site).

Lolo National Forest in Sanders Co. Clark Fork River drainage. Salamanders found along a steep, cascading brook in a SW facing roadcut ~10 miles due NNW of Thompson Falls. Elevation is 2800 ft. Site is on the north side of Blue Slide Road 9.4 miles from its southern junction with State Highway 200 (Photo. 28a). U.S.G.S. quad: Thompson Falls 15 min. In sect. 26; T23N, R30W. 47°, 43′, 43" lat., 115°, 24′, 52" long. See Map 13.

Site description: This is a rocky section of a creek with cascading, trickling flow. Both creekbed and roadcut slope 35°. The topographic map shows the creek

extending ~1.5 miles up the SW flank of Cougar Peak. Water from the creek pools at roadside and percolates under the road to the Clark Fork River 120 m below. The flow decreased by 30% between 21 May and 15 August.

The roadcut exposes fractured Belt rock and breaks 25° slopes forested in PSME/PHME. Pseudotsuga memziesii is the only dominant tree locally. On the creek there is a 40-50% overstorey of Populus trichocarpa, Acer glabrum, Holodiscus discolor, and Physocarpus malvaceus. What little ground cover there is at creekside consists of bryophyte patches with forbs (Photo. 28b).

Observations: We found three salamanders here during a 20 minute day search on 21 May. Air temp. was 11.7°C, water temp. was 6.4°C, and the sky was completely overcast. The last rain had fallen on 17 May. One immature salamander (3.3 cm SVL) was preserved.

Population: In the area immediately above the road salamanders were easy to find. There may be a large population dispersed along the creek's length (also see R3; 50).

Big Beaver Creek (new site).

Kaniksu National Forest in Sanders Co. Clark Fork River drainage. Salamanders found in a small, SE facing seepage on a roadcut ~11 miles WNW of Thompson Falls. Elevation is 2800 ft. Site is on the north side of Forest Route 152, 8.1 miles from its junction with State Highway 200 (Photo. 29a).

U.S.G.S. quad: Cooper Gulch 15 min. In sect. 5; T22N, R31W. 47°, 42'04" lat., 115°36', 12" long. See Map 14.

Site description: This seepage is near the base of a 45° roadcut that breaks 30° slopes, 10 m above the flood plain of Big Beaver Creek. Primary trees of the floodplain include Populus trichocarpa and Pseudotsuga menziesii. The surrounding hills are forested in PSME/PHMA with Pseudotsuga menziesii and Pinus ponderosa the dominant trees. Shrubs undergrowth near the seepage includes

immature Pseudotsuga menziesii and Populus trichocarpa. Aside from the scant overstorey from a young Populus, the seepage lacks an overhead canopy (Photo. 29b). The seepage is separated from the surrounding forest by 20 m of roadcut that exposes several faces of well fractured Belt mudstone. Most of the substrate within the seepage is loose rock with almost no soil. The ~20 m^2 damp area of the seepage has a dense ground cover of bryophyte mat with Equisetum arvense. Water flow in the seepage is light and apparent only where the bryophyte mat is broken (Photo. 29c). There was no flow reduction between 15 June and 21 August.

Observations: We found three immature salamanders here during a 15 minute day search on 15 June. Air temp. was 27.0°C, water temp. was 10.0°C, and the sky was clear. The last rainfall had occurred on 8 June. One salamander (2.9 cm SVL) was preserved. We stopped searching out of concern that we would damage the microhabitat.

Population: The ease with which we found salamanders, despite the hot day and southern exposure of the seepage, might indicate a fair sized population. However, there does not appear to be much damp area locally, or in the surrounding areas (also see R3; 47, 48).

Cascade Creek (historic site).

Lolo National Forest in Sanders Co. Clark Fork River drainage. Salamanders found in the sprayzone of a ~30 m high series of waterfalls on a north flowing stream, ~11 miles due SSE of Plains. Elevation is 2800 ft. Site is ~0.3 miles south of State Highway 135 at a point ~5 miles from its junction with State Highway 200 (Photo. 30a). U.S.G.S. quad: Quinns Hot Springs 7.5 min. In sect. 19; T18N, R25W. 47°, 18′, 8" lat., 114°, 49′, 30" long. See Map 15.

History: This site was discovered by E. K. Teberg in 1963 (Teberg, 1965), who collected salamanders in the sprayzone of the falls. J. E. Lynch (pers. comm.) reported that salamanders here are difficult to find.

Site description: Cascade Creek is a small, freestone stream that drains a considerable area of the mountains to the south. It is fed by four, first order tributaries, and for this reason has a large seasonal fluctuation in flow: between 23 May and 22 August the stream's volume dropped by 80%. Our work involved the falls and three reaches of the stream adjacent to the falls.

Above the falls the stream flows along a 10^{o} sloped bed on a bench forested in PSME/PHME. There is a 70-80% tree and shrub overstorey. Prominent trees include Pseudotsuga menziesii and Pinus ponderosa (the Pinus is very old). Shrubs include Acer glabrum, Ribes sp., Betula sp., Physocarpus malvaceus, and Symphocarpos alba. Ground cover includes bryophyte mat and Rubus parviflora. There is considerable freestone in this reach. There are also secure cobbles and deadfall covered in bryophyte mat. (Photo. 30b). There are few cascade areas, especially in the spring when the creek is swollen.

At Cascade Creek Falls, the creek drops ~30 m down a $70\text{-}80^{o}$ rockface of fractured Belt mudstone. There are four major cascades, including an upper fall ~15 m high and three lower falls each ~5 m high. The habitat type immediately around the falls is THPL/CLUN which grades into a sparse PSME/CARU(?) and SCREE on the surrounding slopes. Overstorey at the upper fall is scant and at the lower falls between 30 and 50%, almost entirely composed of Thuja plicata. Except for immature Thuja, there is little shrubby growth. There is considerable bryophyte mat covering the sprayzone of the falls, varying between the ~50% coverage at the upper fall (Photo. 30c), to the nearly complete coverage at the lower falls (Photo 30d). At the base of each fall rubble and deadfall have accumulated and are covered with bryophyte. The amount of this material increases as one moves down the rockface.

At the base of the rockface the creek cascades for ~30 m down a boulder accumulation sloped 40°, and then flows another ~30 m at 15-20° as the colluvium grades into soil. The habitat type here is THPL/CLUN. There is an 80% overstorey of Thuja plicata and some Pseudotsuga menziesii. What little shrub growth there is here includes Acer glabrum, Holodiscus discolor, and Symphocarpos alba. Living ground cover is mostly bryophyte mat (Photo. 30e). The creekbed here is a ~15 m wide floodplain overwhich the stream splits into three main branches. These eventually unite into a single, freestone stream that flows through a PSME/PHYAL habitat type ~300 m to the Clark Fork River. This last reach of the stream is similar in slope, overstorey, and plant associations, to the reach above the falls. The tree composition differs; this area is forested in Pseudotsuga menziesii and Larix occidentalis.

Observations: We performed counts here during the day and night of 23 May, during the night of 13 June, and during the day on 14 June. In the interest of safety we did not search the falls area at night.

The daytime search on 23 May included ~70 m of the creek above the falls and the falls themselves. Air temp. was 22.8°C and water temp. was 6.1°C. The sky was clear and the last rain had fallen on 21 May. During the night of 23 May we searched ~100 m of creek below the falls. Air temp. was 12.8°C water temp. was 6.9°C, and the sky was clear. We found no salamanders above or below the falls. We did find one male Ascaphus truei in the colluvium at the base of the falls. We found 18 salamanders in the falls area.

The nighttime search on 13 June included ~30 m of creek above the falls and ~30 m of creek immediately below. Air temp. at the start of the search above the falls was 16.8°C and the water temp. was 10.6°C. Air temp. at the start of the search below the falls was 12.2°C and water temp. was 8.9°C. The sky was clear. Local air temp. the preceeding day was ~30°C and the last rain had fallen on 8 June. We searched the falls on 14 June. Air temp. was 17.8°C,

water temp. was 10.0°C, and the sky was clear. During these searches, as with the 23 May searches, we found no salamanders above or below the falls. We found 12 salamanders in the falls area.

Population: The best salamander microhabitat appears to be that in the sprayzone of the falls. We looked for salamanders under all the moveable debris here but much material could not be moved. Despite this we found alot of salamanders. For this reason we think the population here is likely very large (see also R3; 64, 65, 66).

Trout Creek (new site).

Lolo National Forest in Mineral Co. Clark Fork River drainage. Salamander found in a seepage on a SE facing roadcut due SSW of Superior. Elevation is 3960 ft. Site is on the north side of Forest Route 320, 14.3 miles from Superior city limits (Photo. 31a). In sect. 24; T15N, R27W. 47°, 02′, 12" lat., 114°, 57′, 36" long. See Map 16.

Site description: The site is on a 40° slope, 90 vertical m above Trout Creek. Adjacent slopes are forested in PSME/PHMA. The slope above the site of capture looks like an old burn, with immature Pseudotsuga menziesii and Pinus ponderosa. There are two seepages comprising ~200 m^2, separated by 20 m (Photo. 31b). Both seepages include fractured Belt mudstone rockfaces, ~5 m high, with accumulations of gravelly rock below. Water in the northeastern of the two seepages (Photo. 31b), emerges at roadside. The southwestern seepage (Photo. 31c), where we found the salamander, is fed early in the season by a brooklet that emerges 250 vertical m to the NE. This brooklet went completely underground between 24 May and 23 August, but water flow in the seepages seemed to drop by only ~10%. Water is culverted beneath the road at the northeastern seepage and percolates into riprap. The brooklet has a 60-80% overstorey of Cornus stolonifera, Betula sp., and immature conifers. The bed of the brooklet

comprises mud-impacted cobbles covered in bryophyte mat. There is little bryophyte mat on either seepage rockface, and only scant overstorey.
Observations: We found one immature salamander here during a 45 minute day search on 24 May. The salamander (1.9 cm SVL), which we preserved, was found in gravel in the southwestern seepage. Air temp. was 20.0°C, water temp. was 10.0°C, and the sky was clear. No rain had fallen since 19 May. Our search involved both seepages and 30 m of the brooklet.
Population: Given the difficulty we had finding salamanders, plus the small area of good microhabitat, we estimate this to be a small population (also see R3; 67).

Woodman Creek (historic site).

Burlington Northern land and Lolo National Forest in Missoula Co. Clark Fork River drainage. Salamanders searched for along a small creek 8.5 miles WNW of Lolo. Elevation is ~4000 ft. Site is on an unnamed road, 3.4 miles from its junction with U.S. Highway 12. U.S.G.S. quad: Blue Mountain 7.5. In sect. 20; T12N, R21W. 46°, 47′, 03" lat., 114°, 15′, 24" long. See Map 17.
History: We were informed of this site by R. B. Brunson (Pers. Comm.) who said he found one salamander here "in the 1960s". This animal was found beneath bryophyte mat some distance from free water.
Site description (no photographs): In the areas we searched, Woodman Creek is a small stream flowing along a 10° sloped bed. The surrounding hills have been either logged or burned. The habitat type may have at one time been in the PSME series. Trees growing on the 30° slopes rising from creekside are mostly Pinus ponderosa. The stream has a 30% overstorey of Acer glabrum, Cornus stolonifera, Betula sp., and Ribes sp. Ground cover includes bryophyte mat with mixed grasses and forbs. There are few cascades.

Observations: At dusk on 10 June we searched in likely looking spots along ~1 mile of creek and in bryophyte covered scree on the slopes above the creek's east bank. Air temp. was 20.0°C, water temp. was 7.2°C, and the sky was clear. The last rain had fallen on 8 June. We found no salamanders.

Population: The salamander population here, if it exists, may be small.

Sweathouse (new site).

Bitterroot National Forest in Ravalli Co. Clark Fork River drainage. Salamander found in the 200 m^2 sprayzone of an 8 m high water fall on the south side of a SE flowing stream. Elevation is 5000 ft. Site is approximately 2 miles (by U.S.F.S. Trail 121) upstream from the end of Sweathouse Creek Road. U.S.G.S. quad: Gash Point 7.5 min. In sect. 29; T8N, R21W. 46°, 25′, 29" lat., 114°, 15′, 23" long.

Site description: Sweathouse Creek, in the area below the falls, rapidly flows along a 10° bed in a steeply walled gorge of exposed granite. Slopes of 40° rise from the creek's margins. The creekbed is exposed granite and is littered with boulders and heavy deadfall. The margins of the stream are free of soil, presumably due to fluctuating water levels. Where protected from washout, soil has accumulated and bryophyte mat grows.

The surrounding habitat type is ABGR/CLUN, with Abies grandis, Pseudotsuga menziesii, and Pinus ponderosa the major trees. Streamside growth includes Acer glabrum, Ribes sp., and immature conifers. At the base of Sweathouse Falls there is a scant forest overstorey. On the south side of the stream below the falls (where we collected the salamander), the ground cover is mostly grass and some bryophyte. Soil overlays a colluvium of granite boulders that have presumably fragmented from the cliff overwhich the stream falls. The interstices of this colluvium form underground galleries above the floodzone of the creek (Photo. 32).

Observations: We collected and preserved and adult female (5.1 cm SVL) salamander here on 25 May. The salamander was found within an underground gallery beneath a cobble. The site of capture was ~3 m from streamside and ~5 m from the base of the falls. The ground here was damp from spray coming off the falls. We found two Ascaphus truei (male and female) beneath separate cobbles in the same area. Air temp. was 10.6°C, water temp. was 5.6°C, and light rain was falling from an overcast sky.

We found one salamander in ~2 hours of search. We searched both sides of the stream 50 m above and 50 m below the falls. There is a small seepage emerging from fractures along the north edge of the waterfall, which we unsuccessfully searched. We also searched wet areas on Trail 121 on our way to the falls.

Population: We were hampered in our ability to search by the lack of moveable objects and rock at streamside. Also, the stream on 25 May was carrying snowmelt and it is possible that local nighttime substrate temperatures were so low that salamanders were deep underground. The area of sprayzone here, plus the colluvium of rock, could provide suitable conditions for a medium-large population.

Section R2. Salamander observations.

Table 1 characterizes substrates associated with the 126 adult (A) and 110 immature (I) Coeur d'Alene Salamanders we observed during this study. Site and date of observation are indicated; (D) indicates day count, (N) indicates night count. Dates of night counts are for the preceeding day, although night counts were sometimes performed in early morning.

Pertinent site data and climatic observations can be found in Section R1. Descriptions of wetness and substrate indices are given in Materials and Methods. Day count substrates were reducible to the following numbered code. 1, salamander found beneath (in contact with) bryophyte mat. 2, salamander found by digging in (gravel) Rock 2. 3, salamander found by digging in Rock 3. 4, salamander found by moving Rock 4. 5, salamander found in rock fracture. 6, salamander beneath wood fragments.

Site/Date	Age	Wetness	Temp. ^{o}C	Substrate Type
Troy 2				
3 June. '87 (N)				
S. of road	A	3	8.9	Vertical bryophyte mat
	A	2	8.9	Bryophyte mat
N. of road	A	1	8.9	Rock 3
	A	2	8.9	Rock 1
	I	2	8.9	Rock 2
	I	4	8.3	Bryophyte/rock 2
	I	4	8.3	Rock 2
	I	2	9.4	Rock 2
	A	3	8.9	Rock 3
	A	2	9.4	Rock 2
	I	2	8.3	Rock 2
Troy 1a				
3 June. '87 (N)	A	3	10.0	Vertical rockface
Troy 1b				
31 May '87 (N)				
West seepage	A	3	7.8	Vertical rockface
	I	3	7.2	Vertical rockface
	A	3	7.2	Vertical rockface
	I	3	7.8	Bryophyte mat

Site/Date	Age	Wetness	Temp. °C	Substrate Type
Troy 1b				
31 May '87 (N)				
West seepage	I	1	7.2	Soil
	I	2	7.2	Soil
	A	2	7.2	Rock 2
	A	2	7.8	Rock 2
	A	1	7.8	Vertical bryophyte mat
Middle seepage	A	4	7.8	Soil
	I	2	7.7	Rock 1 (at roadside)
	A	2	7.7	Rock 2
	A	2	6.7	Bryophyte mat
	A	3	6.9	Bryophyte/soil
	I	3	7.8	Rock 4
	I	3	8.3	Rock 3/bryophyte
	I	2	7.2	Bryophyte mat
	A	3	7.2	Bryophyte mat
	A	3	7.5	Vertical bryophyte mat
	I	3	7.2	Vertical rockface
	A	2	6.7	Soil
	A	4	7.2	Soil
	A	2	7.2	Bryophyte mat
	A	2	7.7	Bryophyte mat
	A	3	6.7	Vertical bryophyte mat
	A	4	7.2	Vertical bryophyte mat
	A	2	7.0	Log
	A	2	7.0	Soil
	A	3	6.7	Bryophyte mat
	I	2	6.9	Bryophyte mat
	A	3	7.2	Rock 4
	A	2	8.3	Rock 1 (at roadside)
	A	3	7.2	Bryophyte mat
	I	4	7.2	Soil
East seepage	A	1	8.3	Rock 2
	A	1	8.3	Rock 2
	A	1	7.8	Rock 2
	A	2	7.5	Soil
	A	3	7.8	Rock 3
	A	3	7.5	Bryophyte mat
	A	2	7.2	Bryophyte mat
	A	4	7.8	Bryophyte mat
	A	3	7.2	Vertical rockface
	I	3	6.7	Rock 4
	I	2	6.4	Bryophyte mat
	I	2	7.2	Bryophyte mat
	A	2	8.3	Rock 1 (at roadside)
	A	3	7.2	Rock 2
	I	3	7.2	Rock 2
	A	3	8.3	Soil
	A	3	8.3	Rock 3
	A	2	7.8	Vertical bryophyte mat

Site/Date	Age	Wetness	Temp. °C	Substrate Type
Troy 1b				
31 May '87 (N)				
East seepage	A	2	8.3	Soil
	A	2	8.9	Soil
	A	3	8.3	Vertical bryophyte mat
	I	3	8.9	Vertical bryophyte mat
	A	4	7.8	Bryophyte mat
Troy 1b				
4 Jun. '87 (D)				
Middle seepage	A	4	10.0	1
	I	3	8.9	2
	I	3	8.9	2
	A	3	10.0	3
East seepage	I	3	10.0	1
	I	2	9.4	3
	I	2	9.4	3
	I	2	9.4	4
Troy 1c				
3 Jun. '87 (N)	A	4	13.3	Soil
	A	4	13.3	Soil (completely submerged)
	A	2	11.7	Soil
	I	3	10.0	Rock 1
	I	2	10.0	Vertical rockface
	A	3	10.0	Vertical rockface
	I	2	10.6	Vertical rockface
	A	3	8.9	Soil
	A	3	8.9	Rock 4
	I	3	8.9	Rock 4
	I	3	8.9	Rock 2
	A	3	8.9	Rock 2
	I	3	8.9	Rock 2
	A	3	8.9	Soil
	A	4	8.9	Rock 3
	I	2	8.9	Rock 2
Troy 1d				
3 Jun. '87 (N)	A	4	6.7	Soil
	A	3	6.7	Bryophyte mat
	A	2	6.7	Bryophyte mat
	I	3	12.7	Vertical rockface
	A	2	11.9	Rockface
	A	3	10.6	Rockface
	A	2	11.7	Vertical Bryophyte mat
	A	2	8.9	Bryophyte mat
	I	1	10.0	Climbing Equisetum arvense
	I	1	10.0	Bryophyte mat
	A	2	11.1	Vertical bryophyte mat

Site/Date	Age	Wetness	Temp. °C	Substrate Type
Troy 1e				
3 Jun. '87 (N)	I	3	10.6	Vertical rockface
	A	2	13.9	In rockface fracture
	I	3	14.4	Vertical rockface
	I	3	14.4	Vertical rockface
	I	1	12.2	In rockface fracture
	A	2	12.2	In rockface fracture
	A	1	13.3	In rockface fracture
	A	1	13.3	In rockface fracture
	A	1	12.7	In rockface fracture
	I	3	12.7	Vertical rockface
	A	3	12.7	Vertical rockface
	I	2	10.0	Bryophyte mat
	I	2	10.6	Rock 1
	A	3	10.6	Rock 1/bryophyte
	I	2	10.0	Soil
	A	1	9.4	Vertical bryophyte mat
	A	3	9.4	Vertical bryophyte mat
	I	1	9.4	Soil
	A	2	10.0	Bryophyte mat
	A	2	10.0	Bryophyte mat
	A	3	11.1	Bryophyte mat
	A	4	9.4	Soil
	A	3	10.0	Vertical rockface
	A	2	10.6	Vertical bryophyte mat
	A	2	11.1	Bryophyte mat
	A	2	10.3	Vertical bryophyte mat
	A	3	11.1	Vertical bryophyte mat
	I	3	13.3	Vertical rockface
	I	3	13.3	Vertical rockface
	I	3	13.3	Vertical rockface
	A	3	10.6	Vertical rockface
	I	3	10.6	Vertical rockface
	A	3	10.6	Rock 1
	I	1	10.6	Vertical bryophyte mat
Troy 3				
4 Jun. '87 (D)	I	2	8.9	2
	A	4	8.3	2
	A	4	8.3	2
	I	3	10.0	3
Troy 5				
3 June. '87 (N)	A	2	8.3	Rock 2
	A	1	12.2	Vertical bryophyte mat
	I	1	10.0	Fallen limb
	I	1	9.4	Log
	A	1	11.1	Soil
	A	2	10.0	Bryophyte mat

Site/Date	Age	Wetness	Temp. °C	Substrate Type
North Troy 1				
31 May '87 (D)	A	2	9.4	1
Surprise Gulch				
19 May '87 (D)				
Above road	I	2	7.2	3
Below road	I	3	6.1	3
	I	2	7.8	3
	I	3	7.2	3
Surprise Gulch				
31 May '87 (D)				
Below road	I	3	7.8	3
	I	3	7.8	3
	I	3	7.8	3
	I	3	7.8	3
Yaak Falls				
1 June '87 (D)				
Upstream seepage	I	2	8.3	3
	I	2	7.8	3
Downstream seepage	A	2	9.4	3
	I	2	9.4	3
Koocanusa 1				
8 Jun. '87 (D)	I	4	8.7	4
	I	4	8.7	3
	I	4	9.2	3
Koocanusa 2a				
8 June. '87 (D)	A	4	14.0	5
Koocanusa 2b				
8 Jun. '87 (D)	A	2	14.0	3
	I	2	14.0	3
Koocanusa 2c				
8 Jun. '87	A	3	11.0	3
	I	2	11.0	4
Koocanusa 3	I	2	15.1	3
	I	2	15.1	4
Noxon				
16 May '87 (D)	I	2	8.3	1

Site/Day	Age	Wetness	Temp. °C	Substrate Type
Noxon				
20 May '87 (N)	A	2	6.7	Leaf litter
	A	3	8.0	Bryophyte mat
	I	1	7.5	Log
	I	2	7.5	Bryophyte mat
	I	3	8.5	Leaf litter
Noxon				
30 May '87 (N)				
Creekside	I	3	10.0	Bryophyte mat
	A	2	10.6	Leaf litter
Road	A	2	10.6	Pavement
	I	2	11.1	Pavement
	A	2	11.1	Pavement
Scree	A	2	11.4	Rock 3
	I	2	10.6	Rock 4
	A	2	10.0	Rock 4
Thompson 1a				
21 May '87 (N)				
North seepage	A	4	6.4	Vertical bryophyte mat
South seepage	A	4	5.0	Vertical bryophyte mat
Thompson 1a				
14 Jun. '87 (N)				
South seepage	A	1	8.2	Vertical bryophyte mat
	I	1	10.0	Vertical bryophyte mat
Thompson 1b				
21 May '87 (N)	I	3	6.1	Rock 2
Tjompson 1b				
14 Jun. '87 (N)	I	3	10.8	Vertical bryophyte mat
	I	3	10.8	Vertical bryophyte mat
	I	1	13.1	Bryophyte mat
Priscilla Gulch				
21 May '87 (N)	A	4	6.1	Bryophyte mat
	I	3	6.7	Bryophyte mat
Priscilla Gulch				
14 Jun. '87 (N)	I	1	1.1	Bryophyte mat
Barktable Creek				
21 May '87 (N)	A	2	6.7	Soil

Site/Day	Age	Wetness	Temp. °C	Substrate Type
Barktable Creek				
14 Jun. '87 (N)	A	1	13.3	Bryophyte mat
	I	1	12.2	Bryophyte mat
Sims Creek				
21 May '87 (D)	I	1	7.8	2
	I	2	6.1	2
Cougar Gulch				
21 May '87 (D)	I	3	6.7	3
	I	3	6.7	3
	I	3	7.2	2
Cascade Creek				
23 May '87 (D)				
Fall 1	I	1	10.6	4
	A	3	14.0	1
	A	3	11.1	1
	A	3	11.1	1
	I	3	14.0	6
	I	4	9.0	1
Fall 2	A	4	8.9	1
	A	1	10.6	3
	A	1	10.6	3
	A	1	10.6	3
Fall 3	I	4	8.3	3
	I	2	10.0	1
	I	4	8.6	3
	I	3	10.0	4
	I	3	11.0	1
Fall 4	A	3	11.0	2
	I	4	10.0	1
	A	4	10.0	1
Cascade Creek				
14 June '87 (D)				
Fall 1	A	3	14.0	1
	A	3	14.0	1
	I	3	14.0	1
	A	3	14.0	1
	I	4	10.0	1
Fall 2	I	3	11.0	1
	I	3	11.0	1
	I	3	11.0	1
Fall 3	I	2	14.0	1

Site/Day	Age	Wetness	Temp. ^{o}C	Substrate Type
Cascade Creek				
14 Jun. '87 (D)				
Fall 4	A	3	11.0	3
	A	4	10.0	3
	I	4	10.0	2
Trout Creek				
24 May '87 (D)	I	2	13.3	2
Sweathouse				
25 May '87 (D)	4	2	8.3	4

Section R3. Where we didn't find them.

Numbers correspond to those on Map 19. This is a list of locations that, based on our experience, looked like good Coeur d'Alene Salamander microhabitat. It also includes other locations associated with historic sites. This is not a complete list of the sites we unsuccessfully searched (see Section R1) and the distribution of these locations on Map 19 does not reflect the entire scope of our search efforts.

Most of these sites were day-searched only once and thus may actually harbor salamander populations. However, we feel that the distribution of populations on Map 19 depicts the geographic range of the salamander in Montana. Further survey is needed to fill in gaps between known locations. Three outlying areas that need more exploration include the Yaak drainage near the U.S. Canada boundary, the northern Salish Mountains east of Lake Koocanusa, and the Mission Range east of Flathead Lake.

1. Rubble in sprayzone of West Fork Yaak Falls.

2. Moss covered, boggy seepage and two cascading, mossy creeks draining into Sullivan Creek. At roadside on F.R. 92 between 6 and 9 miles from its junction with the north Koocanusa bridge.

3. Mossy, trickling creek and riprap on F.R. 474 near its junction with F.R. 7216.

4. Two gravelly seepages on F.R. 114, 9 and 10.2 miles from its junction with U.S. Highway 93.

   Cascading, mossy creek draining into Graves Creek, on F.R. 114, 12.8 miles from its junction with U.S. Highway 93.

5. Wampoo Creek at State Highway 508. Cascading, freestone stream with mossy cobbles.

6. Rocky seepages on W. side of state Highway 508, 0.5 mile N. of Yaak Falls (night search).

7. Moss covered, boggy seepages on F.R. 176 between Arbo Creek and Seventeen Mile Creek.

8. Arbo Creek at F.R. 176. Cascading, freestone stream with mossy cobbles. Ascaphus truei found.

9. Feeder Creek on F.R. 2394 near Kilbrennan Lake. Mossy with cobbles, trickling flow.

10. Pine Creek between U.S. Highway 2 and the Kootenai River. Mossy, cascading stream with small falls.

11. Mossy, cascading tributary of Ruby Creek at junction of F. R. 4477 and F.R. 582.

    North Fork of Ruby Creek on F.R. 582. Cascading freestone stream with mossy cobbles.

12. Ransom Creek at F.R. 4654. Cascading, freestone stream with mossy cobbles.

    Moss covered, gravelly seepage ~3 miles S. of Ransom Creek on F.R. 4654.

13. Hennesy Creek on F.R. 600. Mossy with cobbles. Trickling flow with cascades.

    Moss covered, cobbly seepage (creek?) ~1 mile S. of Hennesy Creek on F.R. 600.

14. Gravelly seepage on F.R. 4445, 1 mile S. of Surprise Gulch.

15. Koot Creek on F.R. 4445. Mossy, trickling stream.

16. Gravelly seepage on North River Road 7 miles W. of State Highway 37.

17. Damp area (seepage?) on S. side of U.S. Highway 2, due S.E. of Throop Lake (night search).

18. Falls Creek ~1 mile due E. of Savage Lake. Mossy, cascading stream with small falls.

19. Six rocky seepages along 1 mile of the old Troy-Libby Highway, beginning at Troy 3 site.

20. Unnamed stream in Lyons Picnic Grounds. Crosses U.S. Highway 2, 5.8 miles from Lake Creek bridge in Troy. Stream emerges from a spring 20 m above the highway and flows N. to the Kootenai River. Light flow with no cascades (night search).

21. Williams Creek at U.S. Highway 2. Large freestone stream with mossy cobbles (night search).

22. Troy 4 site.

23. Cobbles in sprayzone of Sutton Creek Falls.

24. Moss covered, rocky seepage on E. side of State Highway 37, 0.3 mile from 48 mile marker. Ambystoma macrodactylum found (night search).

25. Tweed creek and nearby rocky seepages on E. side of State Highway 37. Moss covered with a short fall and sprayzone. Ambystoma macrodactylum found (night search).

26. Parsnip Creek at F.R. 228. Freestone stream with mossy cobbles.

27. Geibler Creek at F.R. 228. Freestone stream with mossy cobbles.

28. Ural Creek at F.R. 228. Freestone stream with mossy cobbles.

29. Rubble and deadfall in sprayzone of Sunday Creek Falls.

30. Rubble and deadfall in sprayzone of Martin Falls.

31. Moss covered, boggy seepages and trickling creeks on Upper Whitefish Lake Road in Stillwater State Forest. Along a section of road between 10 and 15 miles N.W. of Whitefish.

32. Gravelly seepages draining into the North Fork of the Flathead River. On F.R. 210, 4.3, 4.5, 4.7, and 7.3 miles S. of its junction with Camas Road.

33. Moss covered, cobby seepages on S. side of U.S. Highway 2, 0.1 mile E. of 159 mile marker and 0.5 mile W. of 158 mile marker.

    Mossy, cascading creek draining into the Middle Fork of the Flathead River on U.S. Highway 2, 0.6 mile W. of 158 mile marker.

34. Moss covered, rocky and gravelly seepages in Badrock Canyon State Park.

35. Benning Creek at F.R. 4541. Cascading stream with mossy cobbles.

36. Keeler Creek site.

37. Rubble and deadfall in sprayzone of Ross Creek Falls.

38. Big Hoodoo Mountain site.

39. Gravelly seepage on State Highway 200, 1 mile from Montana boundary.

40. Mossy, cascading creek draining into the East Fork of Bull River. At base of Goat Rock on F.R. 407.

41. Skeleton Creek on F.R. 149. Mossy, cascading creek.

42. Ellis Gulch. Mossy, cascading creek.

43. Government Creek on F.R. 159. Cascading freestone creek with mossy cobbles.

44. Rubble in sprayzone of Little Bitteroot Falls.

45. Berry Gulch on F.R. 2211. Mossy, trickling stream.

    Roe Gulch on F.R. 2211. Gravelly seepage.

46. Loose rock seepages on F.R. 154 between 3 and 6 mile markers.

47. Unnamed tributary of South Branch Creek on F.R. 2262, 4.2 miles from its junction with F.R. 152. Cascading, freestone creek with mossy cobbles.

48. Boggy area on F.R. 152, 1.9 miles E. of Beaver Creek site.

49. Moss covered, gravelly seepages on F.R. 7, 16.5 and 16.6 miles from its junction with State Highway 200.

50. Rubble in sprayzone of Graves Creek Falls.

51. Deerhorn Creek on F.R. 56. Cascading freestone creek with mossy cobbles (night search).

52. Large, moss covered rocky seepage on private East Thompson River Road, 15.9 miles from its junction with State Highway 200 (night search).

53. West Fork of the Thompson River. Large, freestone stream (night search).

54. Bay State Creek on private East Thompson River Road, 8.2 miles from its junction with State Highway 200. Cascadeing freestone stream with mossy cobbles (night search).

55. Damp, mossy areas at roadside and along shores of two ponded areas on east side of private East Thompson River Road between 4 and 8 mile markers.

56. Mossy, trickling creek draining into Goat Creek on F.R. 554, 6.3 miles from its junction with State Highway 83.

57. Mossy, trickling and cascading creek on F.R. 901, 4.1 miles from its junction with State Highway 83.

58. Gravelly seepage on F.R. 286, 1 mile from its junction with U.S. Highway 90.

    Gravelly seepage on F.R. 286, 1.4 miles from its junction with U.S. Highway 90.

59. Mossy, trickling and cascading creek (Camp Creek?) on F.R. 352, 13 miles from its junction with F.R. 7.

60. Mossy, trickling and cascading creek draining into Twelvemile Creek, and an adjacent rocky seepage on F.R. 352, 3.7 miles from its junction with F.R. 973.

61. Mossy, trickling creeks, draining into Tamarack Creek, on F.R. 284 between 6 and 8 miles from its junction with State Highway 135.

62. Gravelly seepage on F.R. 217, 3.1 miles S.W. of paved roadway in Plains.

63. Moss covered, boggy seepage on F.R. 1156, 0.6 mile from its junction with F.R. 282.

Nine gravelly-rocky seepages along F.R. 282, between the 7 and 10 mile markers.

64. Gravelly seeps on F.R. 97, 1.4 and 1.7 miles from its crossing of Pardee Creek.

Pardee Creek and tributary on F.R. 97. Mossy, trickling streams with cascades.

65. Flat Creek on F.R. 194. Mossy, trickling stream.

66. Siegel Creek on F.R. 412. Mossy, trickling stream.

Gravelly seepages on F.R. 412, 4.9 and 1.3 miles from its junction with State Highway 135.

67. Boggy seepage on F.R. 320, 12.5 miles from Superior city limits.

Twin Creek on F.R. 320. Mossy cobbles and trickling, cascading flow.

68. North Fork Creek on F.R. 283. Mossy, trickling creek.

69. Gravelly seepage on F.R. 7750 ~1.5 miles from its junction with F.R. 343.

70. Moss covered, rocky seepage on F.R. 343, 6.5 miles from its junction with U.S. Highway 90.

71. Rubble in the sprayzone of Snowshoe Falls.

Moss covered, trickling and cascading creeks draining into the West Fork of the Lolo River. On U.S. Highway 12, 1.8 and 2.2 miles from Montana boundary.

72. Lee Creek on F.R. 699. Freestone creek with moss covered cobbles.

Moss covered, boggy seepage on F.R. 699, 1 mile from its junction with U.S. Highway 12.

73. Moss covered, boggy seepage on F.R. 461, 2 miles from its junction with U.S. Highway 12.

74. Woodman Creek site.

75. Crystal Creek in Turah. Mossy stream with cascades.

76. West Fork Shwartz Creek and adjacent mossy seepage on F.R. 502.

Rocky seepage on F.R. 502, 3.6 miles from its junction with F.R. 4245.

77. Larry Creek in Larry Creek Campground. Freestone stream with mossy cobbles.

78. Mossy, trickling creek and adjacent seepage on F.R. 428, 6.8 miles from Lone Rock School Road.

79. Mossy, cascading creek and adjacent rocky seepage on F.R. 428, 2.1 miles from Ambrose Saddle Summit.

Rocky seepage on F.R. 428, 1 mile from Ambrose Saddle Summit.

Mossy, cascading creek on F.R. 428, 0.8 mile from Ambrose Saddle Summit.

80. Gravelly seepages and freestone streams draining into Rock Creek. On F.R. 102 between Little Hogback Creek and Ranch Creek.

81. Fulkerson Creek on F.R. 1321. Mossy, trickling stream.

82. Gash Creek on F.R. 737. Cascading, freestone stream.

Moss covered, rocky seepage on F.R. 737, 0.5 mile from Gash Creek.

83. North Fork of Lost Horse Creek on F.R. 429. Freestone stream with mossy cobbles.

Moss covered, muddy seepages on F.R. 429, 9.4 and 6.7 miles from its junction with county road 79.

Mossy, cascading creek on F.R. 429, 10.7 miles from its junction with county road 79.

84. Mossy, cascading creeks draining into Daly Creek. On State Highway 38, 5.2, 2.1, and 1.7 miles from Skalkaho Falls.

85. Rubble in sprayzone of Skalkaho Falls.

86. Spring Gulch on F.R. 91. Moss covered, gravelly seepage.

87. Spruce Creek draining into Hughs Creek. On F.R. 310. Mossy, trickling stream.

Darby Creek draining into Hughs Creek. On F.R. 310. Mossy, cascading stream.

Discussion

The microhabitat of the Coeur d'Alene Salamander.

As a consequence of their cutaneous respiration, all plethodontids readily lose water through evaporation (Spotila, 1972), and most species are intolerant of high temperature (Feder, 1982). Plethodontids are thus restricted to cool, damp environmental conditions and in most temperate zones, these conditions must have some constancy, so as to allow foraging and the fat storage necessitated by seasonal dormancy (Feder, 1983). This dormancy in the Coeur d'Alene Salamander occurs (more or less) between November and April (Nussbaum et al., 1983; Wilson and Larsen, Ms.), although some talus-dwelling populations near Coeur d'Alene Lake (C. Groves, pers. comm.) may also be below-ground during most of the summer months (Houck, 1977; Nussbaum et al., 1983). The requirement of winter dormancy (more accurately, the need to avoid freezing) is an important aspect of the Coeur d'Alene Salamander's ecology and must be considered in any discussion of this animal's microhabitat requirements.

In Montana, most known Coeur d'Alene Salamander populations apparently use bedrock fractures as hibernacula. Possible exceptions are at the Sims Creek site, in which a fracture-zone is not visible locally but likely exists, given the presence of a spring (Fetter, 1980); and the Sweathouse site, where the interstices of a soil-impacted boulder pile probably provide seasonal shelter. In addition to hibernacula, fractures (or boulder pile interstices) provide space for oviposition, as well as shelter from diurnal predators and desiccating conditions. The amount of area underground can thus be an important but, unfortunately, immeasurable component of Coeur d'Alene Salamander microhabitat. A substantial space below-ground could harbor a substantial salamander population. This may, in part, explain why sites so superficially similar (e.g. Troy 1b and Thompson River 1b) have such different population sizes.

Access to existent underground shelter is particularly important to the Coeur d'Alene Salamander because this animal is not fossorially adapted. Fossorial plethodontids such as Plethodon neomexicanus (Reagan, 1972) are characteristically elongate and have reduced limbs (Wake, 1966). Behavioral observations (Wilson and Larsen, Ms.) and the morphology of the Coeur d'Alene Salamander, suggest this animal is best adapted for climbing (see Stebbins, 1951, on Hydromantes platycephalus).

As long as the requirements of shelter, moisture, moderate temperatures, and microenvironmental constancy are met, the Coeur d'Alene Salamander is capable of residing in surprisingly disturbed situations (e.g. Troy 1c). However, the ways in which the (apparently) three main Coeur d'Alene Salamander microhabitats (seepage, waterfall sprayzone, and streamside) meet these requirements differ. These microhabitats are thus different in the type of disturbances each will bear and still support salamanders.

Seepages are an important and durable Coeur d'Alene Salamander microhabitat type. This ultimately stems from constant emergence of spring water with a constant low temperature. All the seepages in which we found salamanders are of the fracture type (Fetter, 1980), providing shelter as well as thermal and hydric stability. Only one of these seepages, Koocanusa 2a, dried substantially during our study, but the salamander population here may be a satellite to that in the more permanent Koocanusa 2b seepage. The persistence of populations in extremely disturbed roadcut seepages (e.g. Troy 1c, Big Beaver Creek) indicate the intrinsic suitability of seepages as Coeur d'Alene Salamander microhabitat. This is further illustrated by the poor overstorey and comparatively dry surrounding habitat of some sites (Troy sites, Big Beaver Creek). Also, although most seepage sites may be oriented to the north, some are southfacing and well exposed to the heat of direct sunlight (e.g. Sims Creek, Big Beaver Creek, Trout Creek).

The biggest seepage populations are those in some of the Teberg sites. These are all northfacing, and the most densely populated have large areas of damp, bare rockface with alot of fracturing (e.g. Troy 1b, Troy 1c, Troy 1e). Water flow varies, but the fractured areas are not completely saturated. Because the Coeur d'Alene Salamander appears to prefer moist to wet, but not very wet, substrate (see Figure 2), heavy water flow that completely saturates a fracture-zone may render a seepage relatively unsuitable as microhabitat (e.g. Troy 2, south of the highway; Thompson River 1b).

Accumulated rubble in a seepage does not appear essential for a healthy salamander population (e.g. Troy 1e) but such material doubtlessly provides additional interstitial space which may serve as daytime shelter (e.g. Troy 1b, Troy 1c, Yaak Falls). Bryophyte growth is a measure of stability and available moisture in a seepage, but its absence does not necessarily indicate a poor salamander population (e.g. Troy 1c).

Three seepages with substantial quantities of soil overlaying bedrock, coincidentally have smallish populations (Troy 1a, Troy 1d, Thompson River 1a). Although factors such as the amount of water flow or extent of bedrock fracturing may be responsible for the apparent paucity of salamanders in these locations, it is possible that soil blocks access to otherwise existent underground shelter, limiting the number of resident salamanders.

Provided that underground shelter is available, the sprayzones of waterfalls produce microhabitat similar to that of seepages and, given sufficient water flow, populations in these situations can be very large (e.g. Cascade Creek; see Lynch, 1984, on Elk Creek Falls in Idaho). Because the supply of water is not intrinsic to these sites; salamanders residing near waterfalls may be sensitive to any upstream factors (e.g. logging or stream diversion) that might cause a severe reduction in water flow, or an increase in water temperature. However, both Montana waterfall sites (Cascade Creek,

Sweathouse) involve streams that drain larger tracts of land than could likely be modified sufficiently to thus reduce populations there. The same may not be said of other streamside sites.

Table 2 shows characteristics of nine streams along which we found the Coeur d'Alene Salamander. All are more-or-less perennial, small creeks with associated fracture zones. Steepness, along with the cascades produced by exposed bedrock, seem important components to the microhabitat associated with these streams. Cascades can dampen areas at creekside, and the fractured bedrock of the creekbeds likely insures moist shelter underground. A low incidence of such conditions may, in part, explain the paucity of salamanders at the North Troy 1 site, and the absence of salamanders along streams associated with known Coeur d'Alene Salamander populations (e.g. Noxon, above the cascade area; Barktable Creek, between roadway and river; stream from Troy 2. Also see Sect. R3; 20).

The North Troy 1 site is also unique among the known streamside sites in having many reaches of freestone bed. This denotes a large seasonal fluctuation in water level in the creek. Such fluctuations reduce the suitability of streamsides as Plethodon habitat because these animals are susceptible to drowning. In addition to helping explain the small population at North Troy 1, the existence of seasonal fluctuation in water level may explain the absence of salamanders along the larger, freestone streams associated with known Coeur d'Alene Salamander populations (e.g. upstream and downstream of the Cascade Creek and Sweathouse sites. Also see Sect. R3; 21, 51, 53, 54).

Some streamside salamander populations are fairly close to stream origins and may thus be protected from high temperatures (e.g. North Troy 1, Surprise Gulch). Other populations are thermally insulated primarily with shade provided by the deep troughs and dense overstoreys of their streams. The importance of shade in maintaining streamside thermal stability probably increases as one

moves downstream, away from a spring source (although the habitat type of more than half the streamside sites is the damp THPL series, the species composition of a stream overstorey is probably not as important as the amount of shade it provides). Many streamside salamander populations are thus vulnerable to reduction or elimination due to increased temperatures, should shade at streamside be greatly reduced. Certain human activities (e.g. "development", logging) are notorious for reducing overstorey on streams with a resultant increase in water temperature, and an increase in water fluctuation and stream flooding (Hynes, 1970). For these reasons, the streamside microhabitat of the Coeur d'Alene Salamander is probably the most readily damaged of the three main types.

We were unsuccessful in searching for salamanders in talus around the Teberg and Thompson River sites. The talus slope microhabitat type reported for the Coeur d'Alene Salamander probably exists in Montana, but not, as reported by Nussbaum et al. (1983), "far from free water". It is likely that populations of salamanders in talus slopes are satellites to those in seepages or at streamsides nearby (See Noxon site description).

The distribution of the Coeur d'Alene Salamander in Montana.

See Map 19. The distribution of the salamander is in part linked to the occurrence of appropriate microhabitat below 5000 feet elevation. This (wet) microhabitat is ultimately a product of indigenous rainfall. The salamander's distribution also reflects certain (Pleistocene and recent) historical events.

All known Coeur d'Alene salamander populations are found in the Columbia Forest Province (Baily, 1980) which, while having severe winters and dry summers, receives relatively heavy precipitation from marine air masses (Daubenmire, 1969; Baily, 1980; Nussbaum et al., 1983). This climate results in the inland appearance of moisture-loving coastal plant species such as Tsuga

heterophylla, Thuja plicata, Abies grandis, and others (Arno, 1979). The distribution of many of these species is similar to that of the Coeur d'Alene Salamander.

To the west, the salamander's known range is bounded by the Okanogan Highlands and the Columbia River Basin (Nussbaum et al., 1983). The latter is desertlike and probably receives too little precipitation (Daubenmire, 1969) to sustain much Coeur d'Alene Salamander microhabitat. The Okanogan Highlands, while receiving more precipitation, have been poorly explored herpetologically (Nussbaum et al., 1983). Savage (1952) hypothesized that Van Dyke's Salamander may occur here.

Coeur d'Alene Salamander populations in Idaho and Montana are found at corresponding latitudes (compare Nussbaum et al., 1983 and Map 19). However, the more humid, rainy climate on the west slope of the Bitterroot Mountains (Baily, 1980) probably results in a greater southern extent of suitable microhabitat in Idaho. The Sweathouse site is probably at the southern extreme of the salamander's Montana distribution. It is situated in a region of comparatively little precipitation and relatively few coastal plant species (Baily, 1980). Our observations indicate that suitable microhabitat in this region (the Bitterroot Mountains to the west, the Anaconda Range and Pioneer Mountains to the south, and the Sapphire Range to the east) is infrequently encountered below 5000 feet. The deep, wet glacier-cut valleys of the Bitterroots (location of Sweathouse) provide the most likely low elevation setting for such microhabitat. Even so, the Sweathouse site is at the salamander's apparent upper limit in elevation.

In extreme northwest Montana and in Canada, Coeur d'Alene Salamander microhabitat at low elevations is fairly common. The scarcity and spotty distribution of the salamander here is undoubtedly related to the Pleistocene presence of ice-sheets that covered much of the land surface above the forty-

eighth parallel (Richmond et al., 1965). Northwest Montana populations now found above this latitude geographically correspond to areas above the upper level of the ice-sheets (compare Richmond et al. and Map 19). Such areas may have provided salamander populations refuge from the presumably severe climatic conditions of the time. Lynch (1984) hypothesized that these northern populations resulted from a northward movement of salamanders following receeding glaciers at the end of the Pleistocene. This is doubtful as regards the Yaak Falls, Surprise Gulch, and Koocanusa populations, however, as the Kootenai River would likely have been an effective barrier to such movements.

Areas above the ice also existed in the (present) upper drainage of the Flathead River and in a glacial lobe in the Rocky Mountains that extended south to the forty-seventh parallel northeast of present-day Missoula. Ice was comparatively deep in these regions (Richmond et al., 1965), however, and ice-free areas may have been at too high an elevation to support Coeur d'Alene Salamander populations. An exceptional area may be in the Mission Range east of Flathead Lake. This region was ice-free during the Pinedale advance of the Pleistocene (Richmond et al., 1965), has low elevations, and its present closeness to the (presumable) thermal stability of the lake make it plausible habitat for the salamander, assuming the salamander occurred this far east in the first place.

At present, in regions to the south and southeast of the Mission Range (drainages of the Blackfoot River, Rock Creek, and other tributaries of the Clark Fork River east of Missoula), suitable microhabitat may only occur in areas too high in elevation for the Coeur d'Alene Salamander. The same can be said of the southern Salish Mountains and much of the lower Flathead River drainage northwest of Missoula.

Locating the Coeur d'Alene Salamander.

Aside from the obvious microhabitat and distributional correlates to its requirement of thermal and hydric stability, the Coeur d'Alene Salamander seems associated with few environmental features that can consistently be used to predict its presence in the wild. As seen in Sect. R1, the local habitat type may be moist (e.g. THPL series) or comparatively dry (e.g. PSME/PHME, as around the Surprise Gulch and Cougar Gulch sites). Also, we found that the presence of moisture-loving vascular plants within potentially suitable microhabitat (e.g. Acer glabrum, Cornus stolonifera, Betula sp.) does not reliably indicate the presence of the salamander (Sect. R3), while some areas almost devoid of vegetation may support healthy populations (e.g. Troy 1c). The same limitations seem to apply to the use of moisture-loving animals to indicate the salamander's presence (e.g. the millipede, Sigmoria sp. that we found in virtually all areas with, but also many areas without the salamander).

Substrate types and ground cover vary considerably between known Coeur d'Alene Salamander sites. For this reason they, also, may be of limited utility as indicators of the salamander's presence in potential microhabitat. However, a consideration of substrates may be somewhat helpful in lessening the time spent searching for the Coeur d'Alene Salamander during the day, in both potential and confirmed locations (see Section R2; substrate types associated with salamanders at night are too variable to be useful. This problem stems from the salamander's tendency to wander while foraging, but is obviated by the fact that this animal is easy to find at night).

Figure 1 shows the daytime frequency of association between the Coeur d'Alene Salamander and five substrate types. This figure is misleading to the degree that; 1, the substrate types occur with variable frequencies in different sites, and 2, certain substrate types (e.g. fractures) may be impossible to

search. For example, bryophyte mat appears favored by salamanders as daytime refuge (and, in fact, we have found a fair number of salamanders over the past three years by lifting loose moss). However, most of the salamanders found associated with bryophyte mat in this study were found at the Cascade Creek site, where bryophyte cover is extensive and other types of refuge are either unavailable to the salamanders or immoveable to searchers.

Since a large size range of rock-fragments can be found in most confirmed sites (but see Sweathouse), the indicated association between salamanders and rock size in Figure 2 may be fairly reliable. The salamanders seem to prefer refuge among rocks of size class 3 (4 cm to 20 cm diameter), which may provide interstices large enough for access and small enough for optimal moisture retention. We have never found the Coeur d'Alene Salamander by digging in sand (Rock 1) or soil, and this probably reflects the animal's lack of fossorial adaptations. For some reason, we have infrequently encountered the salamander beneath wood fragments, although these are fairly common in most sites.

In addition to a consideration of rock fragment size, we have found a consideration of substrate wetness very useful in locating salamanders. The Coeur d'Alene Salamander seems to prefer moist or wet, rather than damp or very wet substrates (Figure 2).

Substrate temperatures associated with salamanders observed during this study (Sect. R2) fall within the range observed by Wilson and Larsen (Ms.). In general, the Coeur d'Alene Salamander may be difficult to find when substrate temperatures drop below $4^{o}C$ or when high daytime temperatures (exacerbated by long periods of little rain) heat up substrates, forcing salamanders deep underground.

Biotic factors influencing the Coeur d'Alene Salamander.

The biotic interactions of the Coeur d'Alene Salamander have been incompletely studied.

Snakes are probably important nocturnal predators. The Wandering Garter Snake (Thamnophis elegans vagrans), the Red-Sided Garter Snake (T. sirtalis parietalis), and the Valley Garter Snake (T. s. fitchi) all reportedly eat salamanders and all occur within the range of the Coeur d'Alene Salamander (Stebbins, 1985). We have retrieved the salamander from stomachs of Red-Sided Garter Snakes on two occasions, once at Troy 1b in 1986, and again on 8 June 1987 at Koocanusa 2b. Nocturnal mammalian predators likely include mustelids and insectivores (see Nussbaum et al., 1983). We have observed Mink (Mustela vison) and shrews (Sorex sp.) at Troy 1b. Young salamanders may be fed upon by the Spotted Frog (Rana pretiosa) and the Long-Toed Salamander (Ambystoma macrodactylum). We have observed these species during night counts at Troy 1b and Noxon, respectively. Also at Troy 1b, we have collected the carabid beetle, Scaphinotus sp., which may prey upon neonates.

Avian predation is assumed to be an important selective factor as regards cryptic coloration, mimicry systems, and behavior in plethodontids (Huheey and Brandon, 1973; Brandon and Huheey, 1975; Semlitsch and Pechmann, 1985; Wilson and Larsen, Ms.). We have observed predation upon an adult Coeur d'Alene Salamander by a Robin (Turdus migratorius) (Wilson and Simon, 1985) at Troy 1b. Bird predators of the salamander may also include other turdids and ictarids; Titmice (Parns sp.) (Hendricks and Hendricks, 1985), Dippers (Cinclus mexicanus), and corvids (Nussbaum et al., 1983).

Given the spatial constraints of its microhabitat (especially in seepages), it is conceivable that intraspecific competition might be an important biotic limiting factor for the Coeur d'Alene Salamander. However, we have never observed behavior that indicates such competition (Thurow, 1976; Keen

and Reed, 1985). Because the Coeur d'Alene Salamander is in microsympatry with only one other urodele (the Long-Toed Salamander), it is doubtful that interspecific competition is very important.

The diet of Coeur d'Alene Salamander in seepages (Wilson and Larsen, Ms.) and at streamsides (Wilson, unpublished data) includes aquatic and semi-aquatic prey, especially dipteran larvae. Such prey are typically abundant in the types of microhabitat favored by the salamander. Also, plethodontids operate on extremely low energy budgets (Feder, 1983). Food availability is thus probably not an important limiting factor to the Coeur d'Alene Salamander, except where habitat damage reduces the numbers or diversity of prey species (Hynes, 1970).

Perhaps the most important biotic factor presently or potentially influencing the Coeur d'Alene Salamander is its amensalistic interaction with people. As mentioned above, such common human activities as logging or stream diversion may reduce the suitability of streamsides as salamander microhabitat. Road building and widening (such as that planned for U.S. Highway 2, between Libby and Troy) could easily eradicate salamander populations, especially those in small, isolated seepages (e.g. Big Beaver Creek).

To help limit any deleterious effects that human activities may have upon populations of the Coeur d'Alene Salamander, we make the following recommendations.

Recommendations for preservation.

1. Within the apparent geographic range of the Coeur d'Alene Salamander (Map 19), natural areas about to be modified by human activities such as logging, mining, or development should be surveyed for the salamander's presence.
2. Known streamside or waterfall populations should be protected against loss of the shade afforded by tree overstorey, and against potential stream flooding, by restricting local and upstream tree cutting.

3. To the extent that it might reduce water flow in streams, damming upstream from known streamside or waterfall salamander populations should be restricted.

4. Seepage populations of the salamander could be removed from areas of impending, but transient, danger; maintained and later released in their home sites. This should be considered for sites now threatened by the proposed widening of U.S. Highway 2 in Lincoln County (Troy 2 and the Teberg sites), and follow-up study on the survivorship of the salamanders involved should be sponsored.

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SITE	STREAM TYPE	BED SLOPE	TROUGH SLOPE	OVERSTOREY	HABITAT TYPE
TROY 5	MOSSY ROCK TRICKLE/CASCADE FLOW	25°	30°	70-80%	THPL/CLUN
NORTH TROY 1	MOSSY ROCK FREESTONE/CASCADE FLOW	15°	30-40°	60-80%	THPL/CLUN
SURPRISE	MOSSY ROCK/MUD TRICKLE/CASCADE FLOW	25°	25-30°	20-60%	PSME/PHME
KOOCANUSA 2c	MOSSY ROCK TRICKLE/CASCADE FLOW	30°	40°	70-80%	THPL/CLUN
KOOCANUSA 3	MOSSY ROCK TRICKLE/CASCADE FLOW	30°	40°	70-80%	THPL/CLUN
NOXON	MOSSY ROCK MODERATE FLOW/CASCADES	30°	20-30°	60-70%	THPL/OPHM
PRISCILLA	MOSSY ROCK TRICKLE/CASCADE FLOW	20°	30-60°	60-70%	PSME/SYAL
BARKTABLE	MOSSY ROCK TRICKLE/CASCADE FLOW	20°	30-40°	60-70%	PSME/SYAL
COUGAR	MOSSY ROCK MODERATE FLOW/CASCADES	35°	20-30°	40-50%	PSME/PHME

Table 2. Characteristics of microhabitat associated with the nine verified streamside populations of the Coeur d'Alene Salamander in Montana.

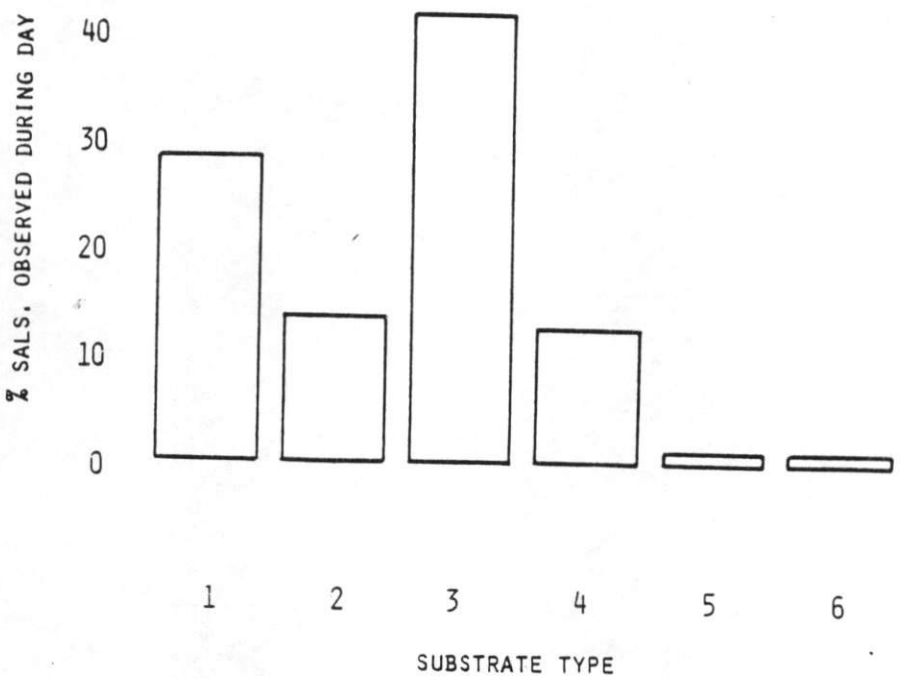


Figure 1. Proportions of (N=73) Coeur d'Alene Salamanders in six substrate associations, observed during day counts. Substrate associations are coded as follows: 1, salamander found beneath bryophyte mat; 2, salamander found by digging in rock fragments between 0.5 cm and 4 cm diam.; 3, salamander found by digging in rock fragments between 4 cm and 20 cm diam.; 4, salamander found by moving rock fragments of more than 20 cm diam.; 5, salamander observed in rock fracture; 6, salamander found beneath wood fragments.

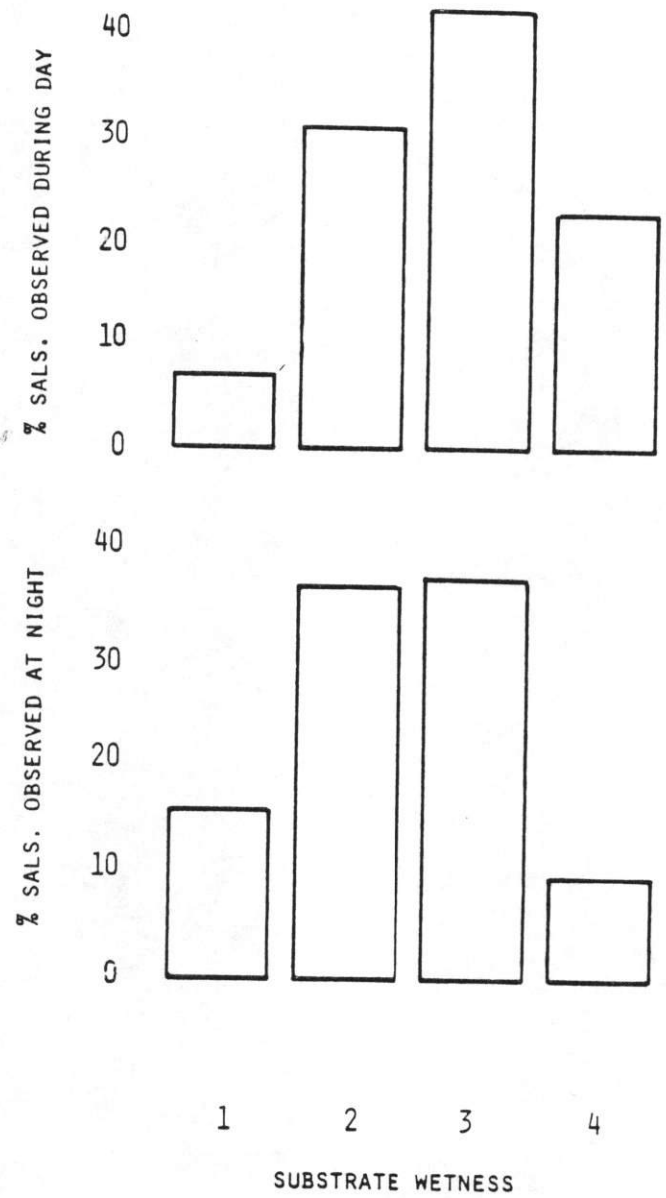
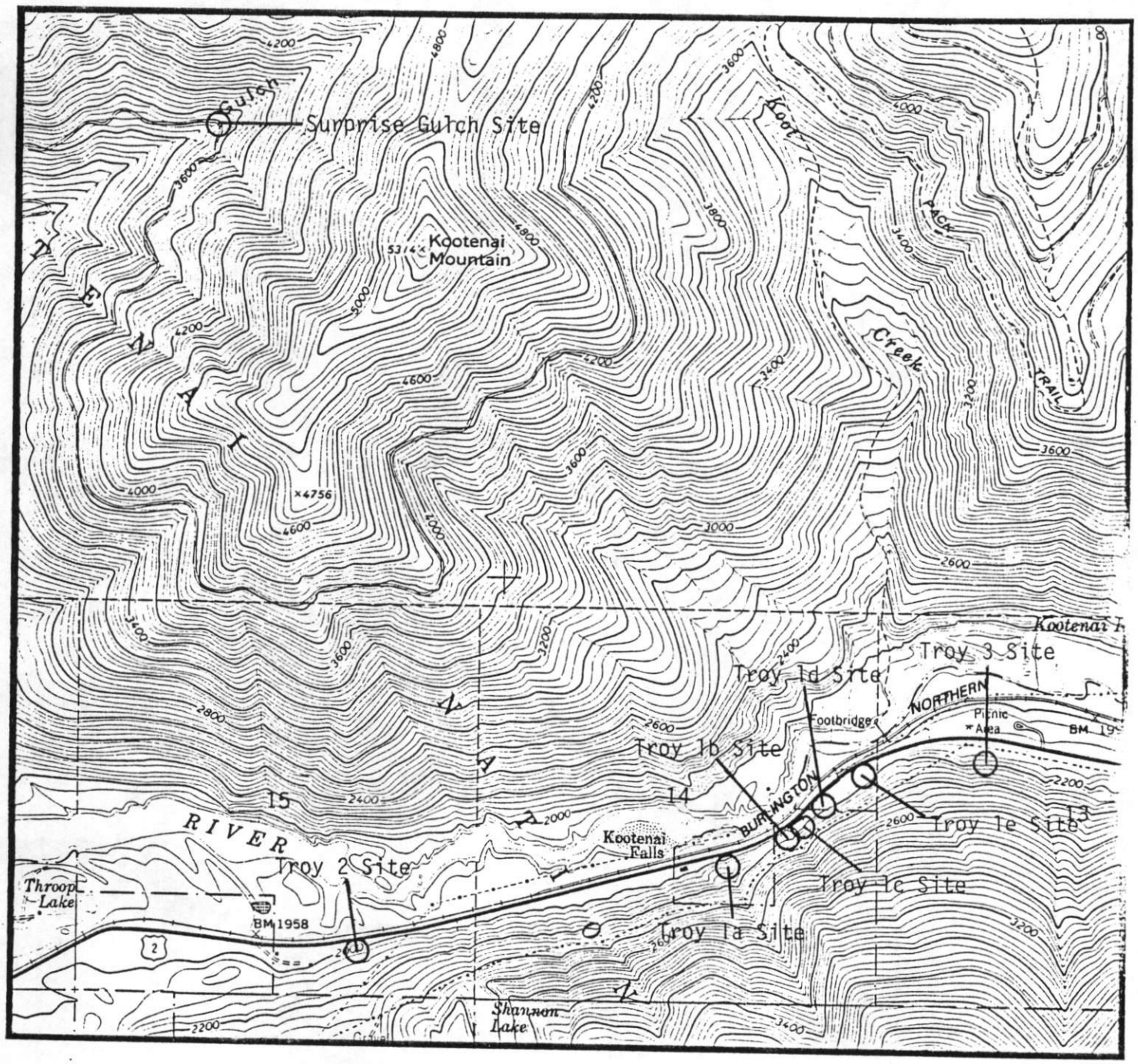


Figure 2. Proportions of Coeur d'Alene Salamanders, observed during day (N=73) and night (N=163) counts, associated with damp (1), moist (2), wet (3), and very wet (4) substrates. See materials and Methods for explanation of the wetness index.

Map 1



SURPRISE GULCH

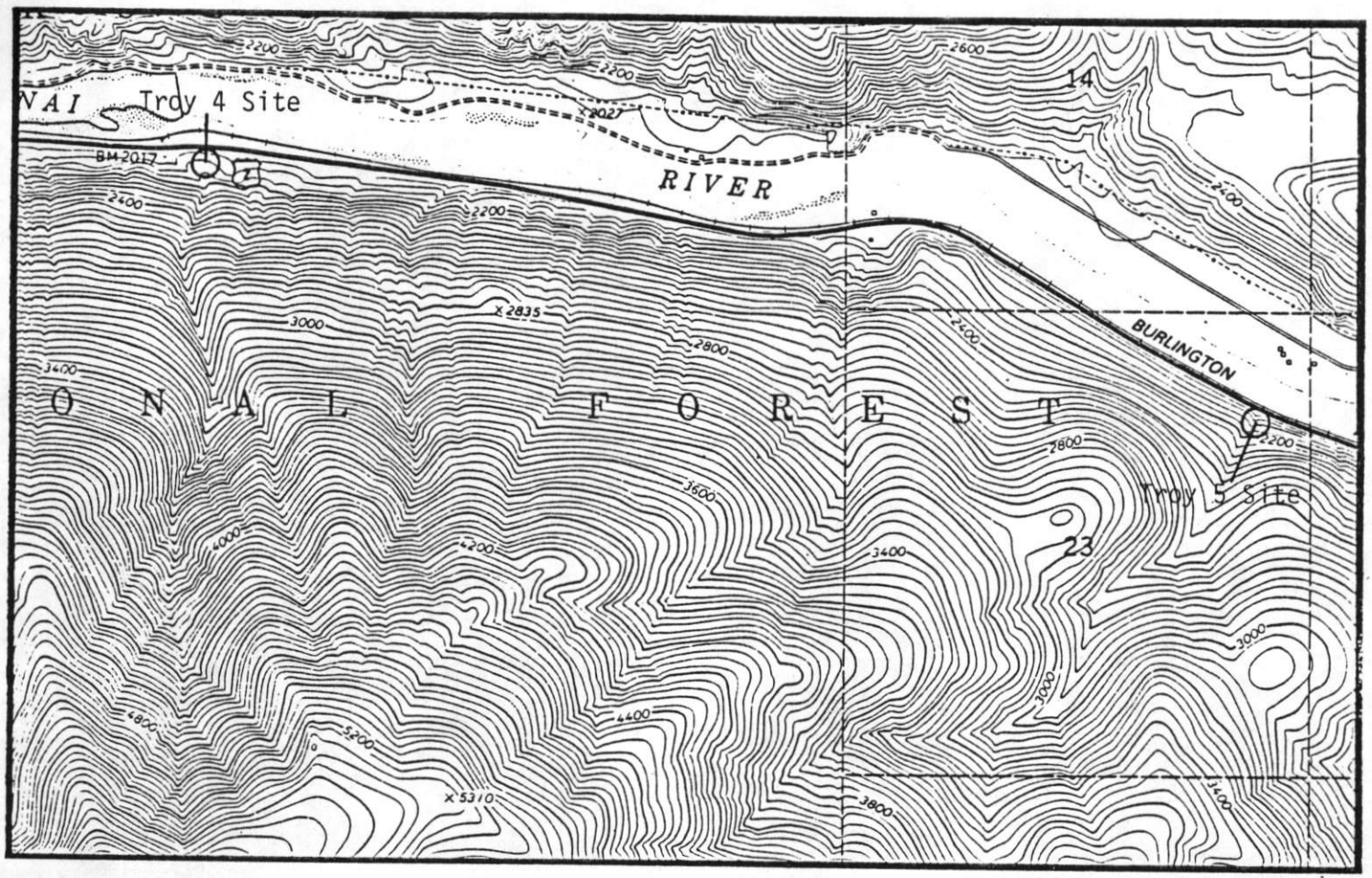
&

TROY SITES 1a, 1b, 1c, 1d, 1e, 2 & 3

SURPRISE COUCH

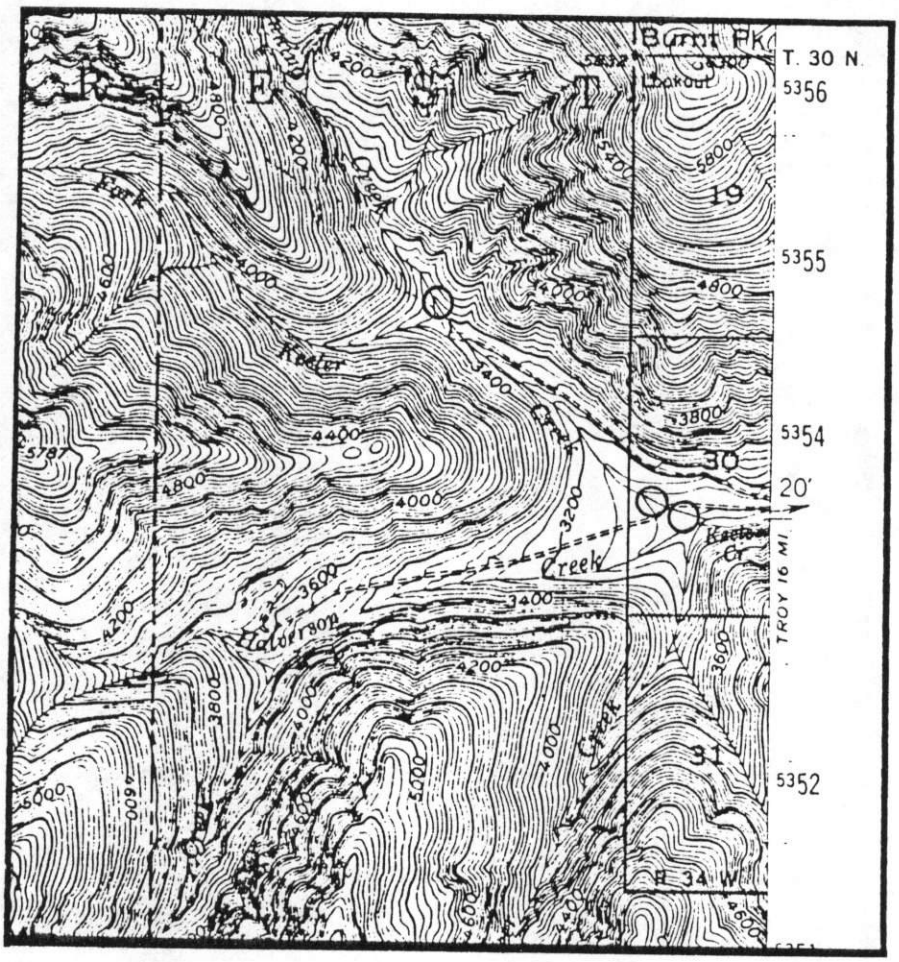
TROY SITES 1a, 1b, 1c, 1d, 1e, 2 & 3

Map 2

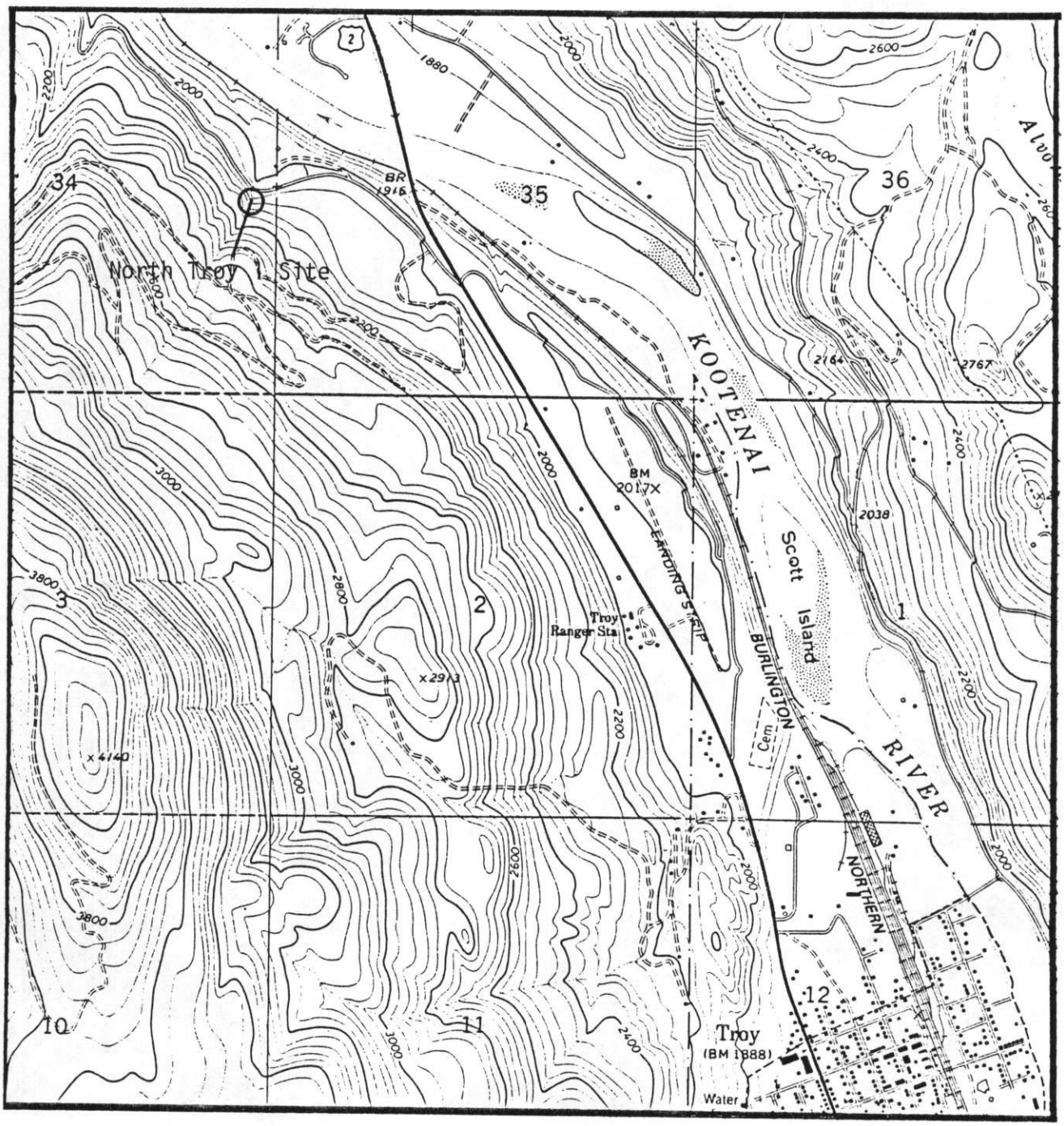

Troy 4 Site
BM 2017
RIVER
BURLINGTON
ONAL FOREST
Troy 5 Site
14
23
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
4200
4400
4800
5200
x 2027
x 2835
x 5310

TROY 4 & 5

Map 3

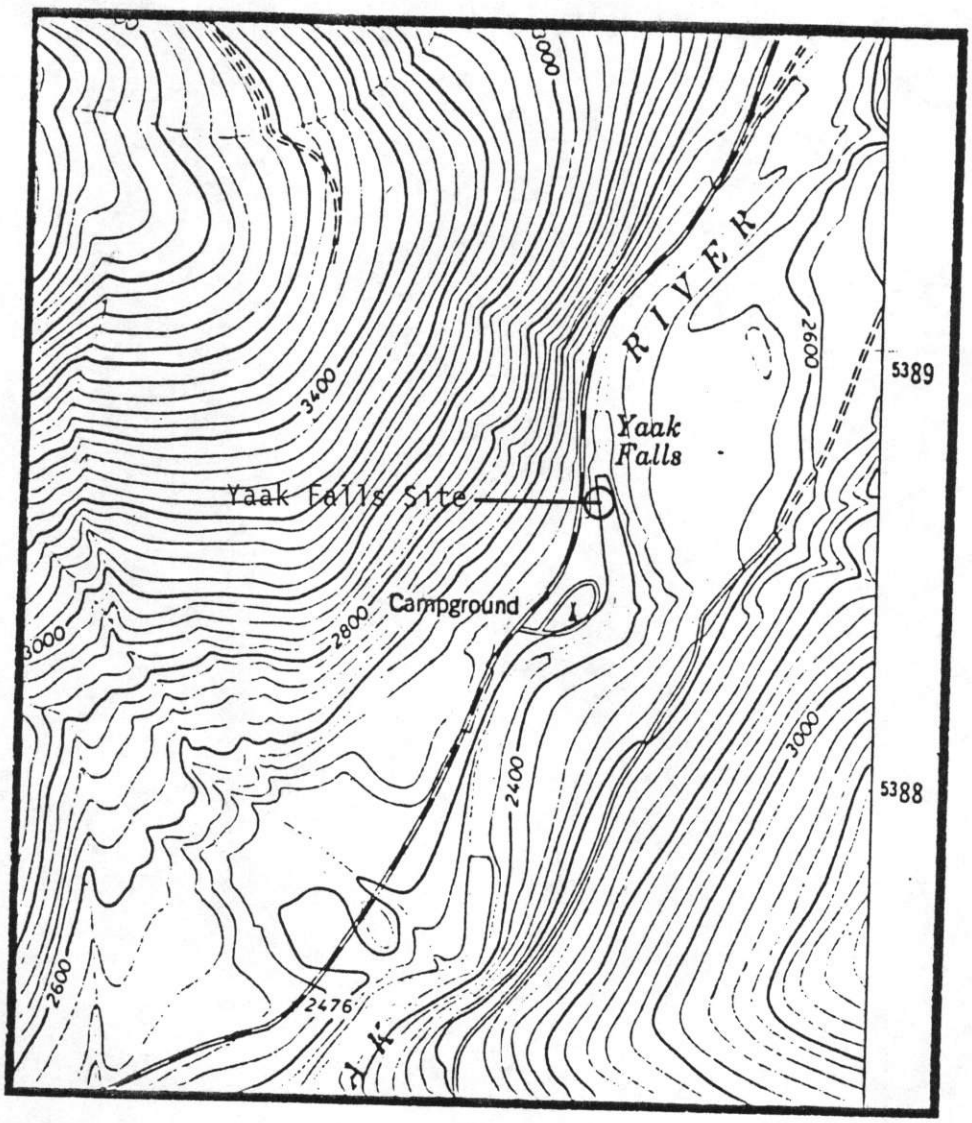


Keeler Creek Site. Circles denote areas searched.


North Troy 1 Site
34
35
36
BR 1916
KOOTENAI
RIVER
Scott Island
BURLINGTON
NORTHERN
LANDING STRIP
Troy Ranger Sta
BM 2017
Cem
Troy
(BM 1888)
Water
2038
2164
2767
x 2913
x 4140
1
2
3
10
11
12

North Troy 1

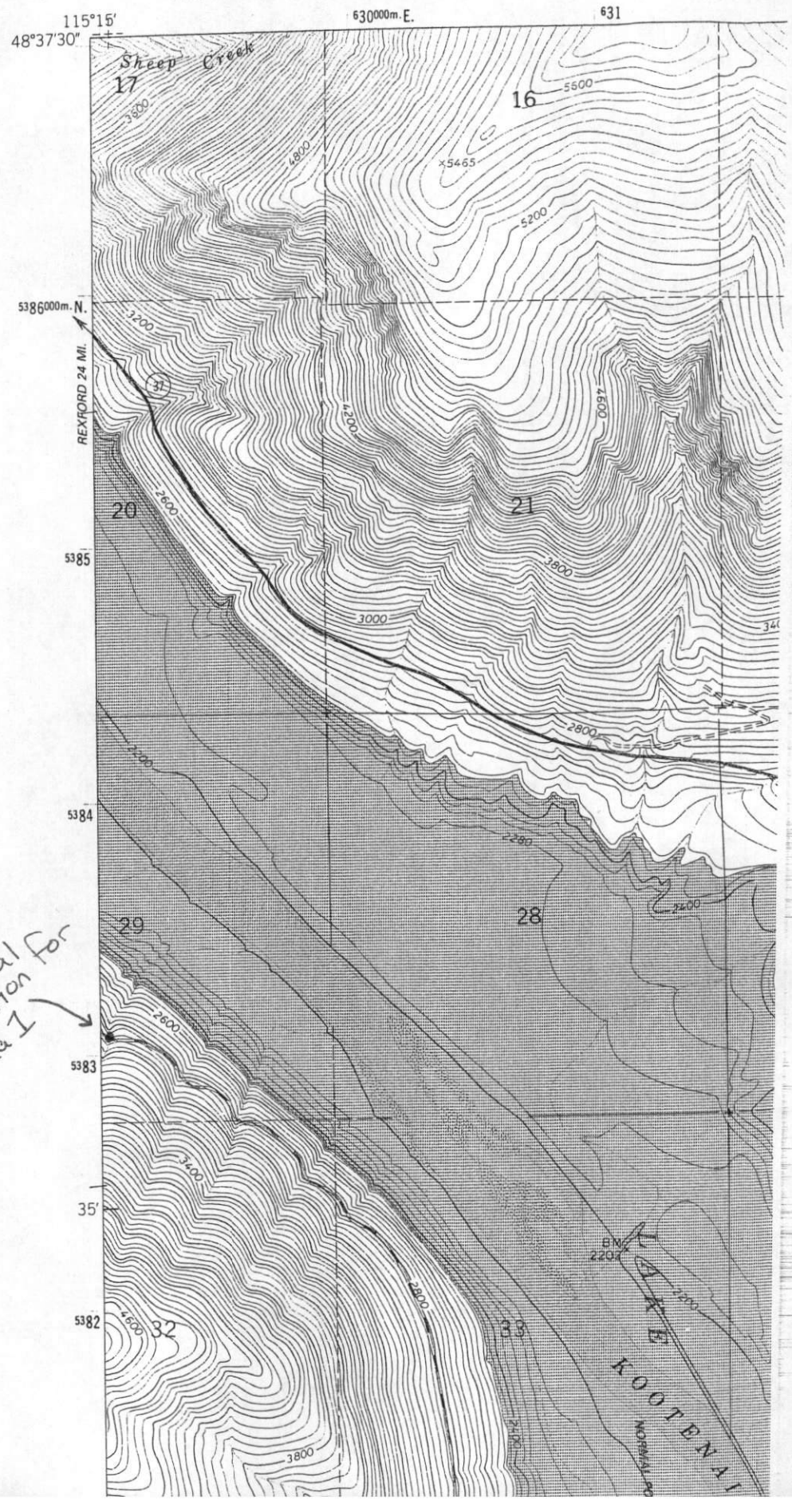
Map 5



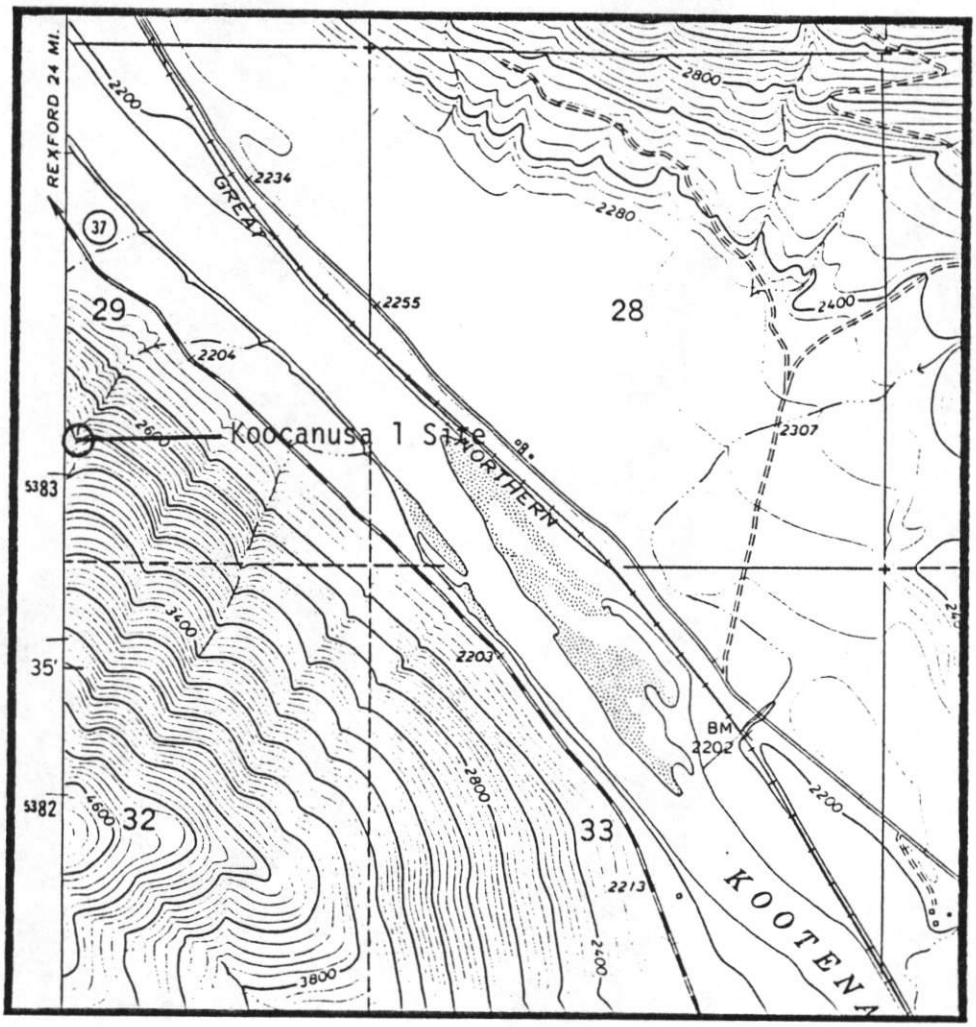
YAAK FALLS

2981 III NE
(INCH MOUNTAIN)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY



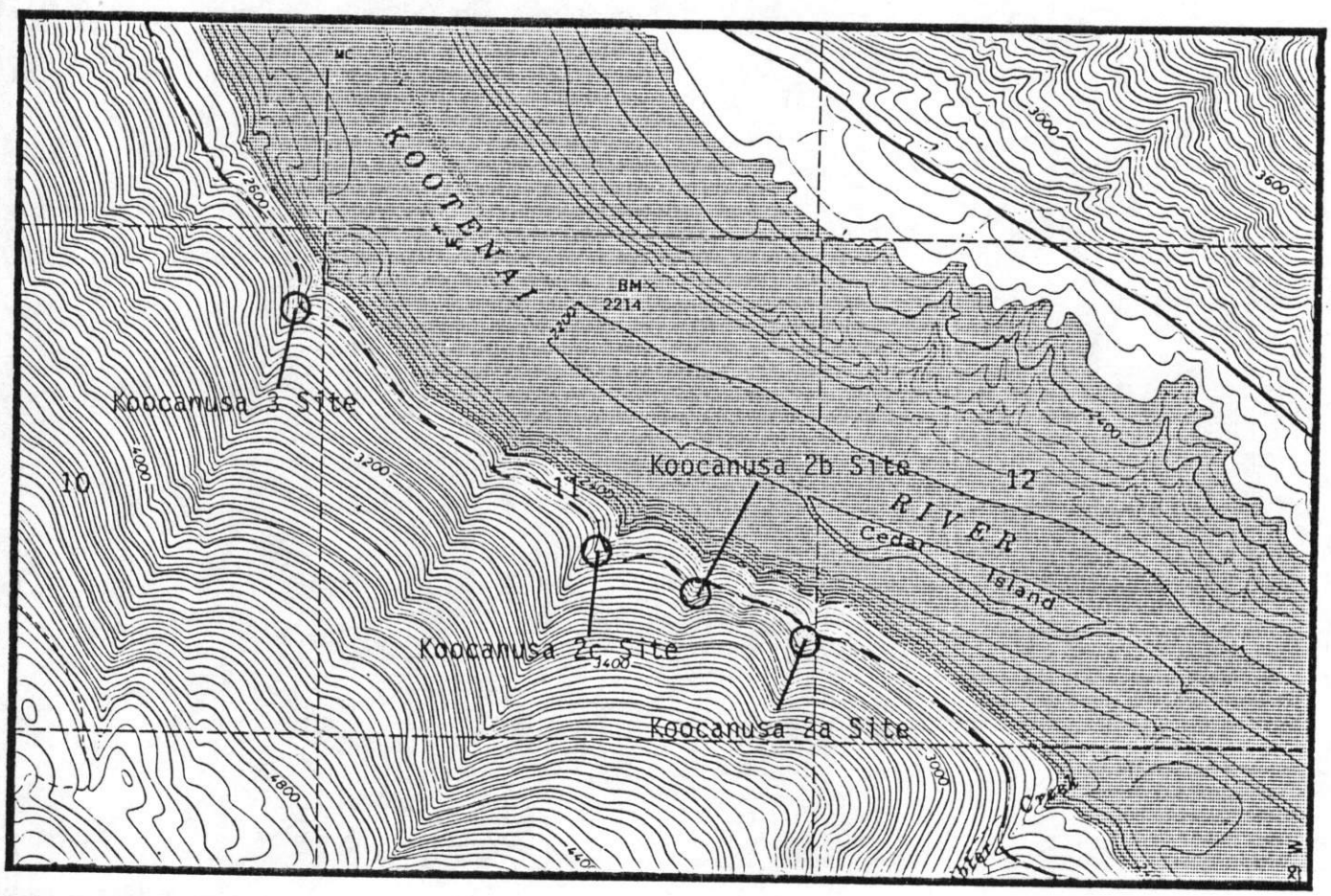
Map from before the dam?



← Koocanusa Site 1

← YOCANUSA Site 1.

Map 8

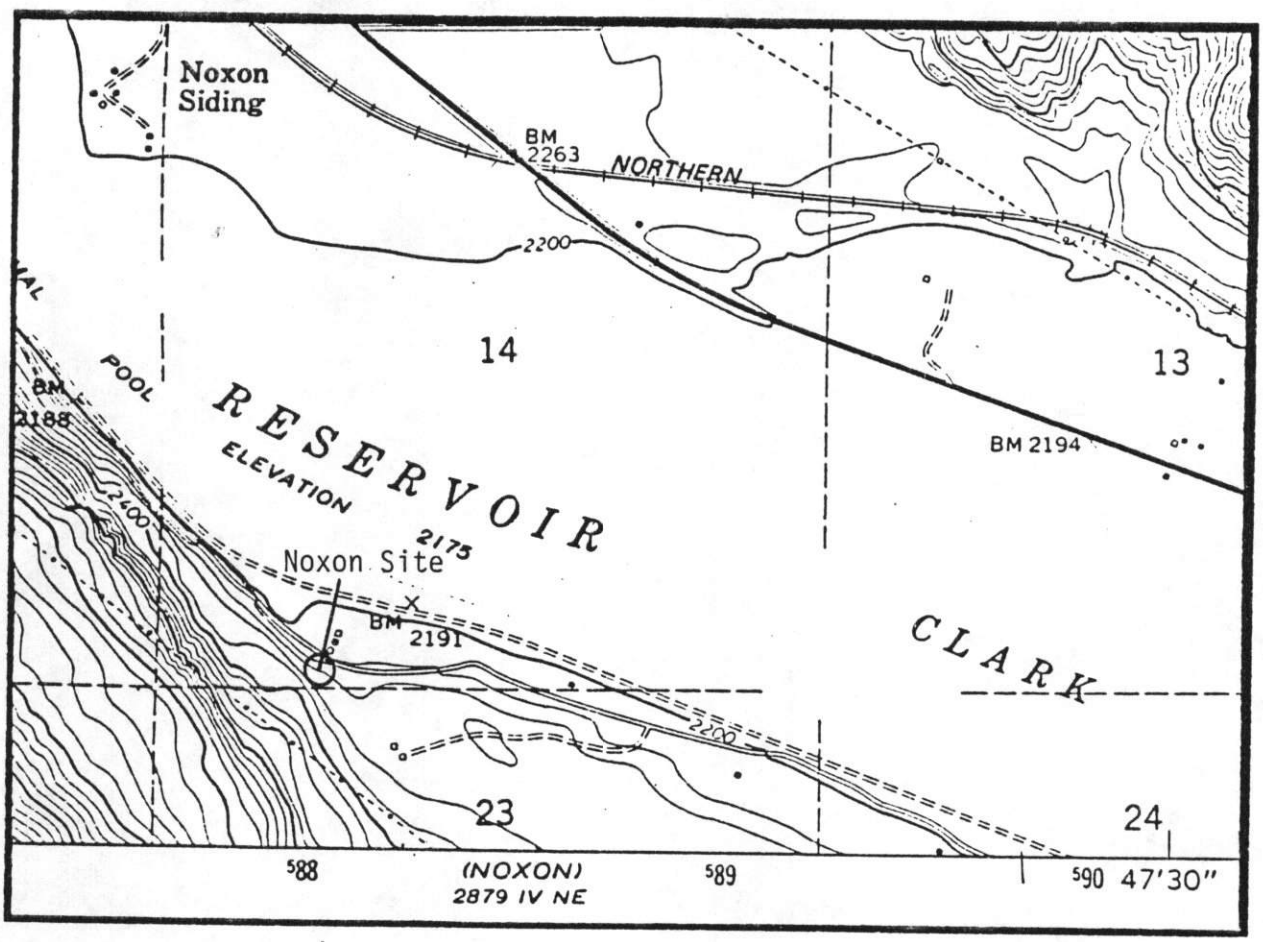


Koocanusa Sites

2a, 2b, 2c, & 3

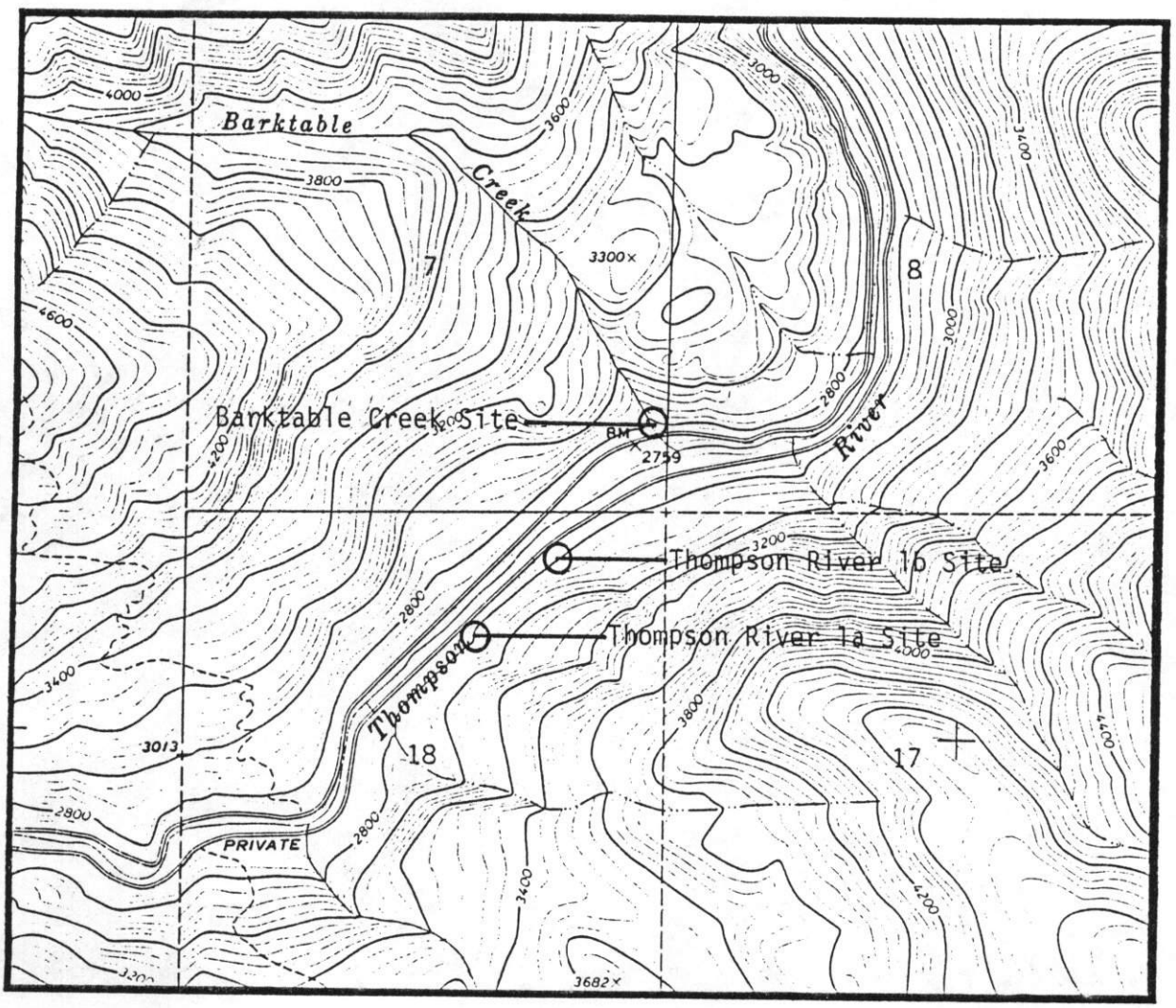
Rosenhusa Sites

2a, 2b, 2c, ¼ 3


Noxon
Siding
BM
2263
NORTHERN
2200
14
13
POOL
BM
2188
RESERVOIR
ELEVATION
2175
2400
Noxon Site
BM 2191
BM 2194
CLARK
2200
23
24
588
(NOXON)
2879 IV NE
589
590 47'30"

Noxon Site

Map 10



BARKTABLE CREEK

&

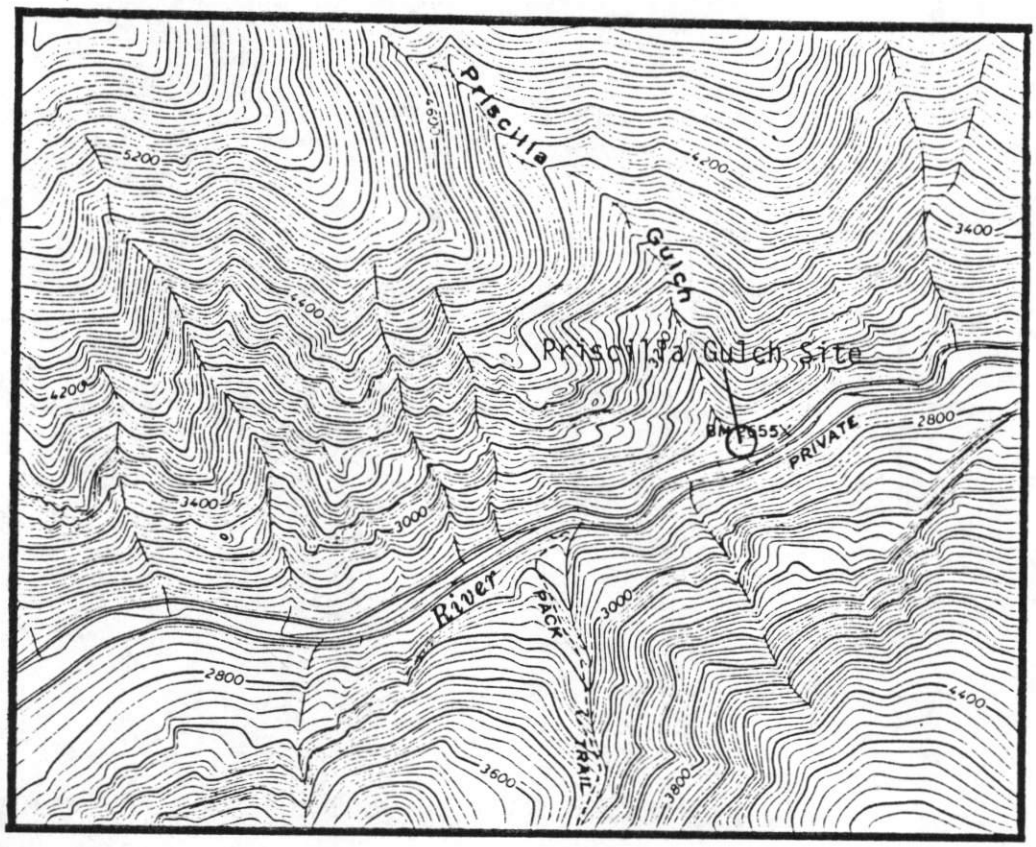
THOMPSON RIVER 1a + 1b

PARKTABLE CREEK

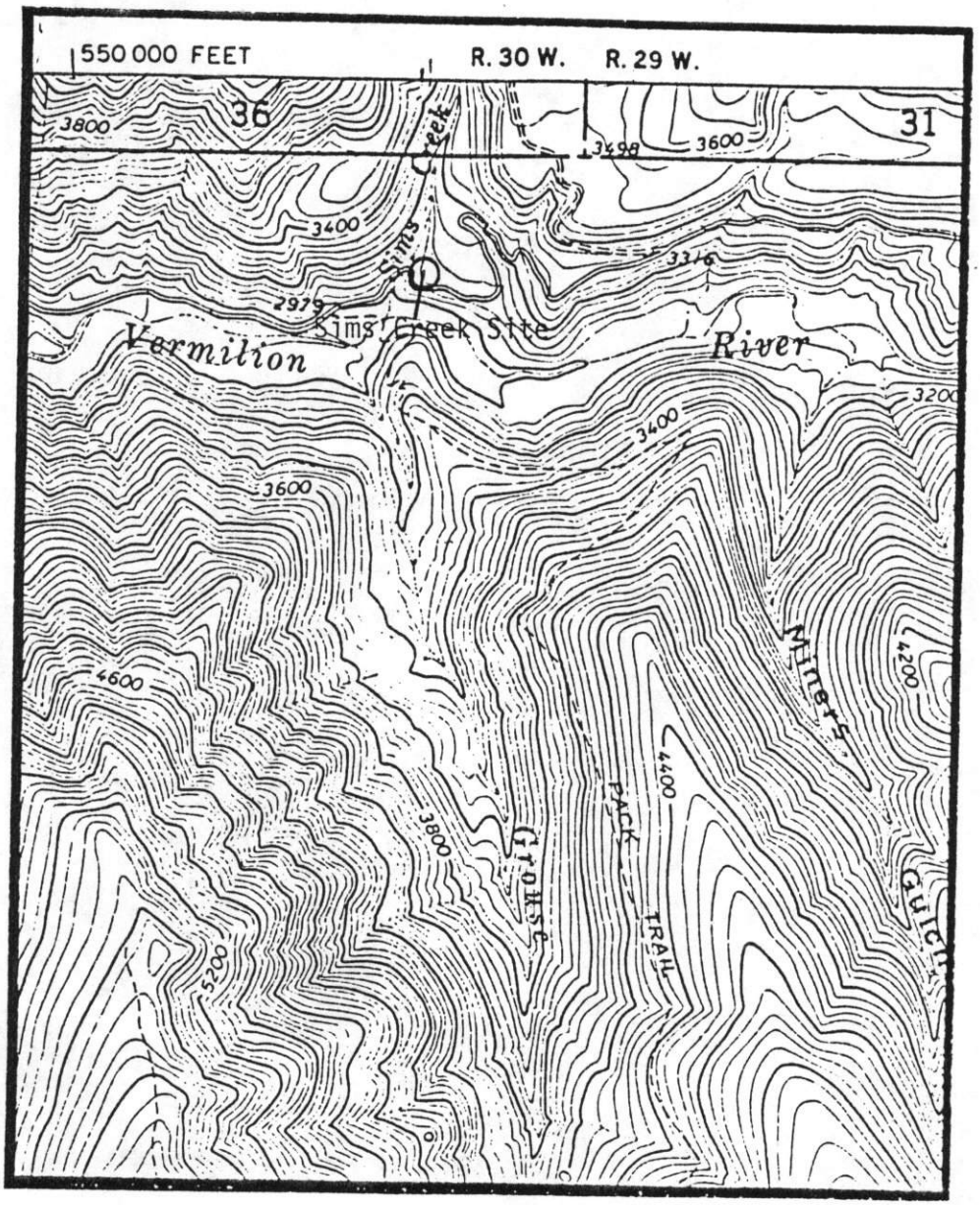
↓

THOMPSON RIVER 1a + 1b

Map 11

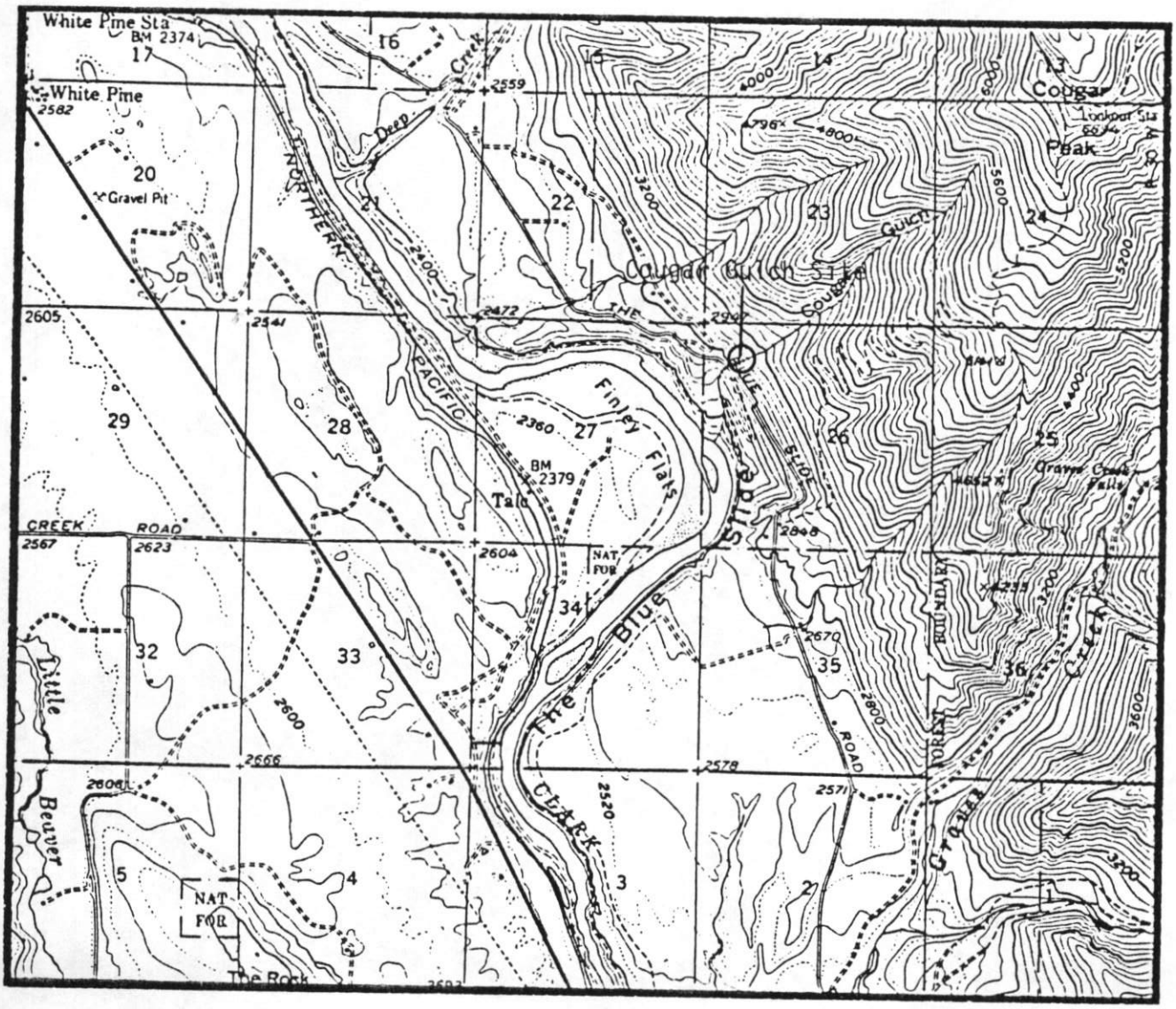


PRISCILLA GULCH


550 000 FEET
R. 30 W.
R. 29 W.
36
31
3800
3600
3498
3400
3316
Sims Creek
2979
Sims Creek Site
Vermilion
River
3200
3400
3600
4600
4200
Miners
4400
PACK
TRAIL
3800
GROUSE
Gulch
5200

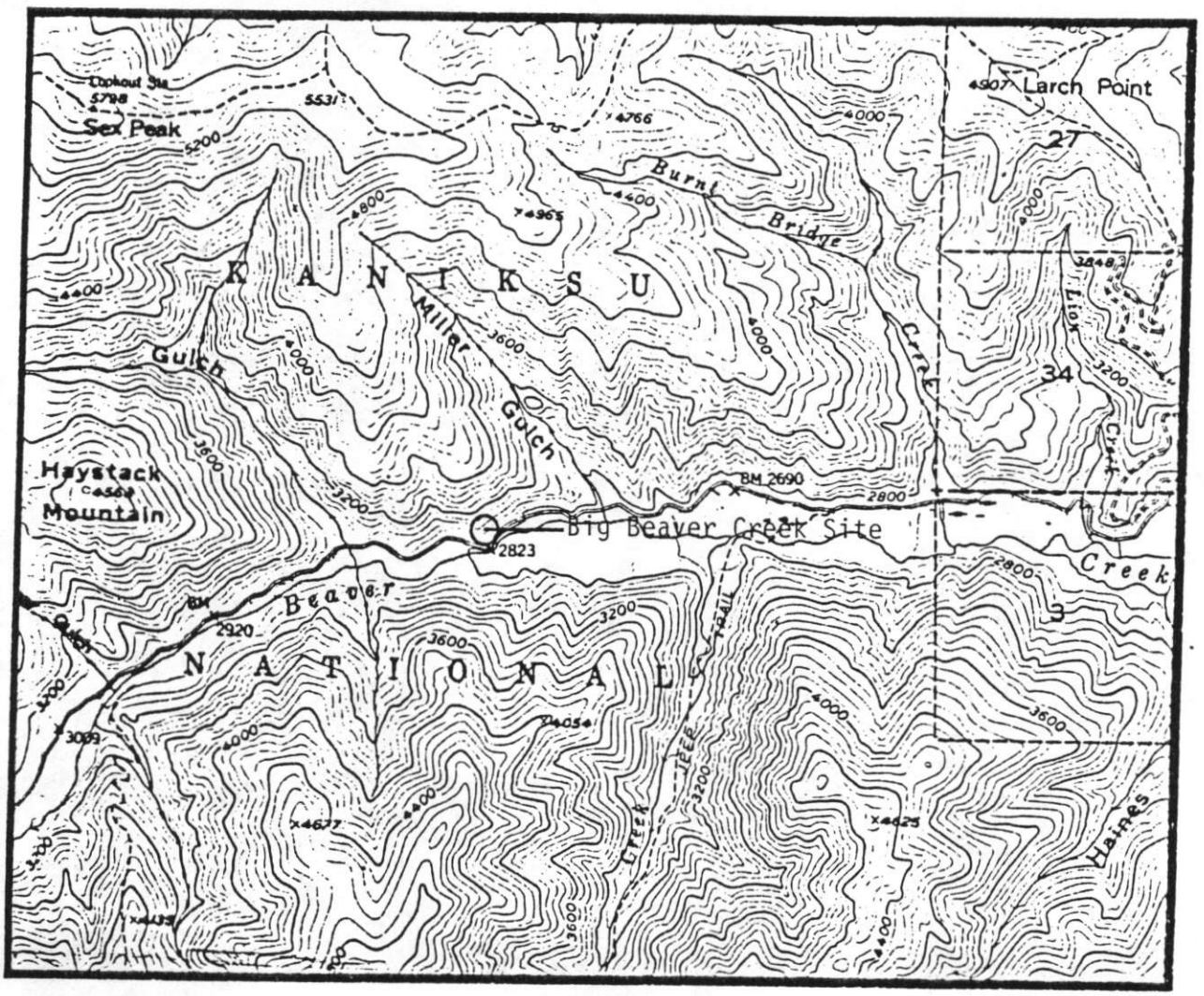
SIMS CREEK

Map 13



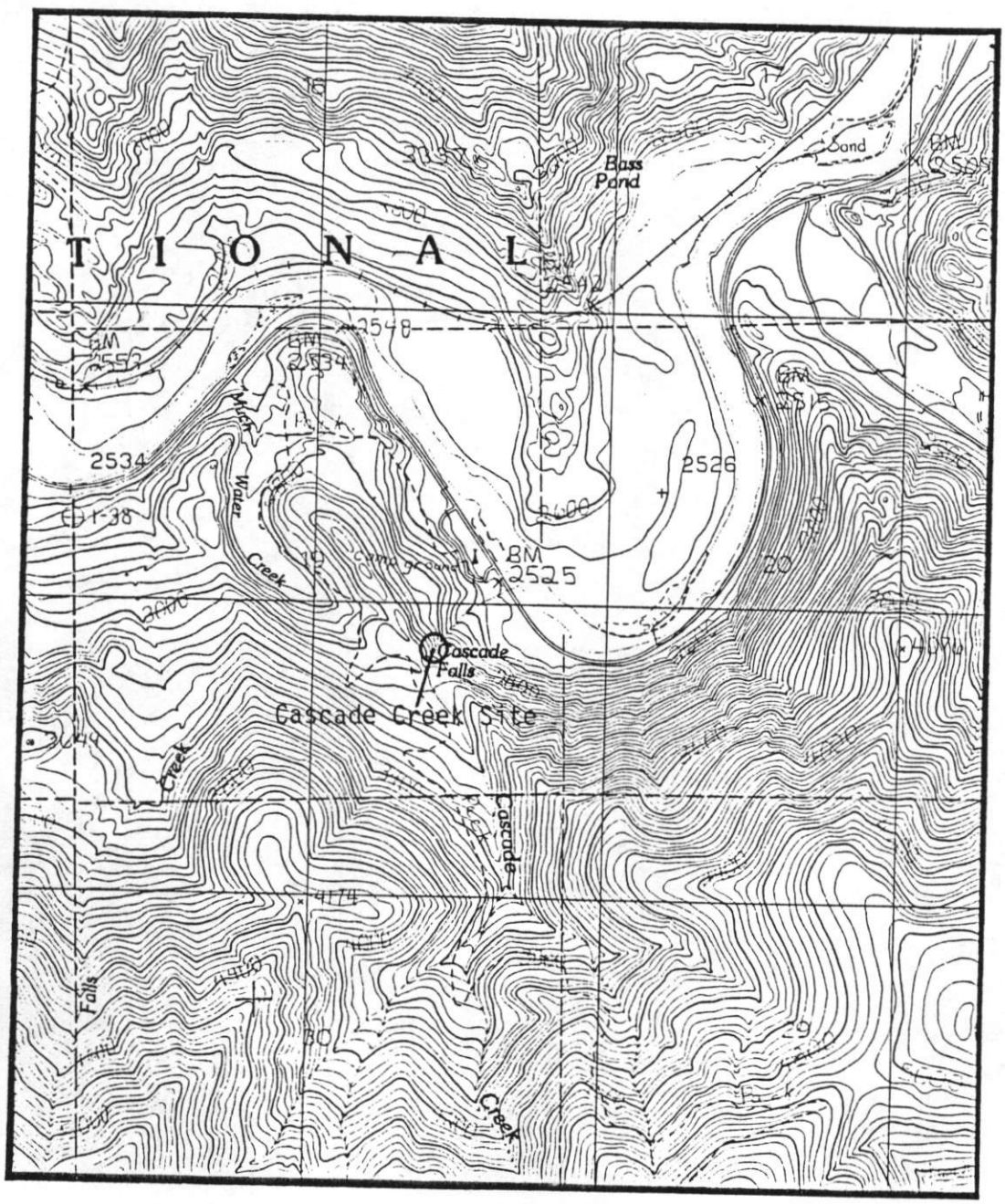
COUGAR GULCH

Map 14



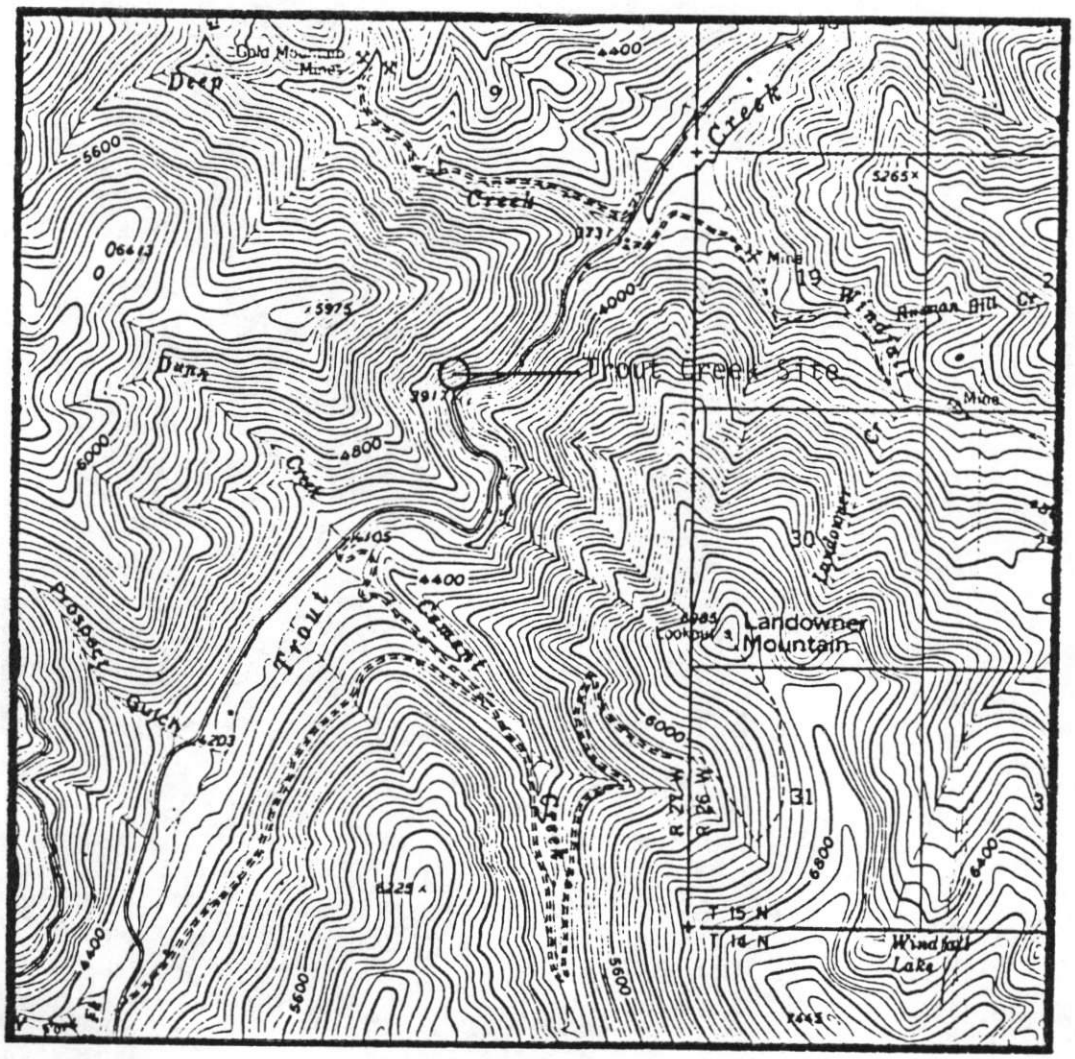
BIG BEAVER CREEK

Map 15



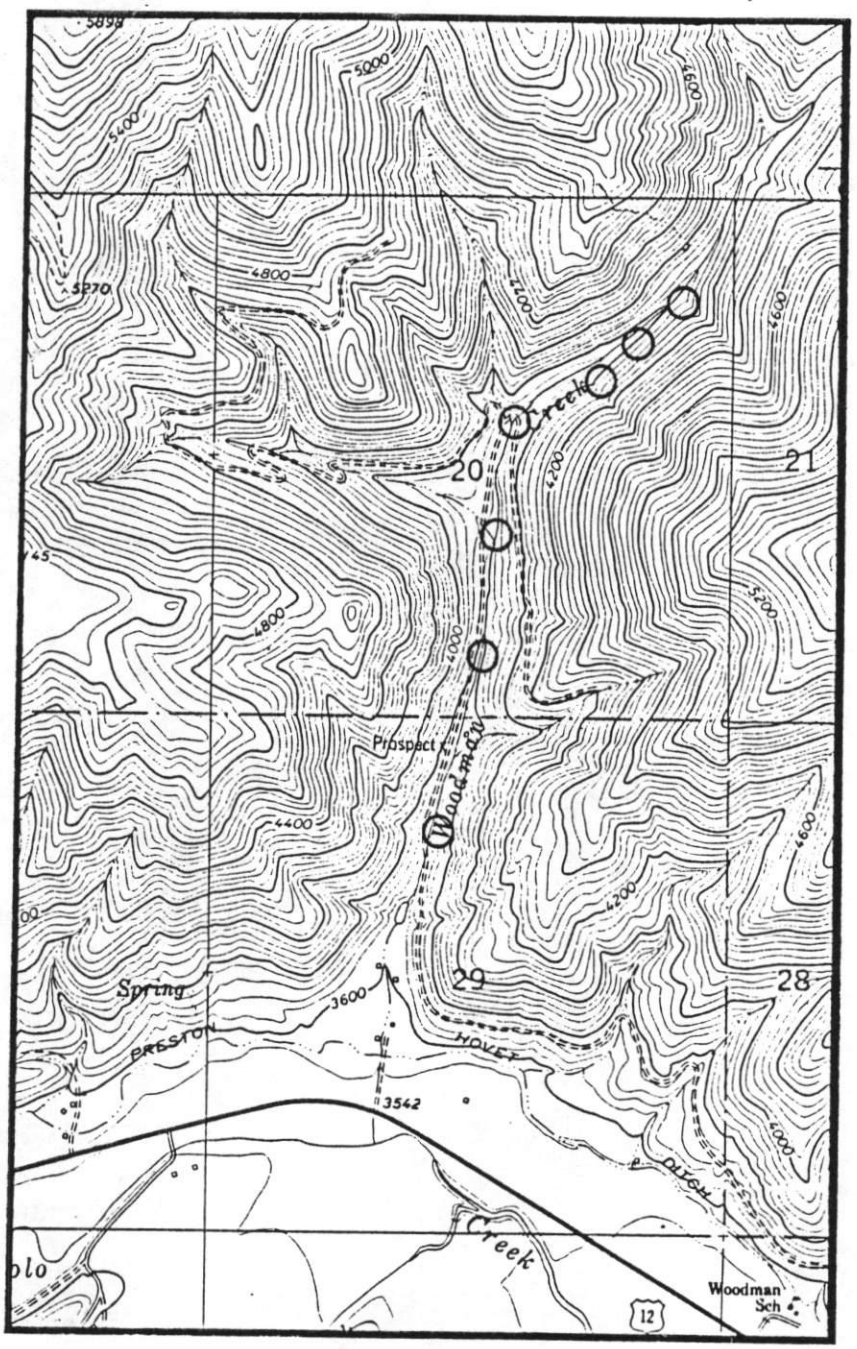
CASCADE CREEK

Map 16

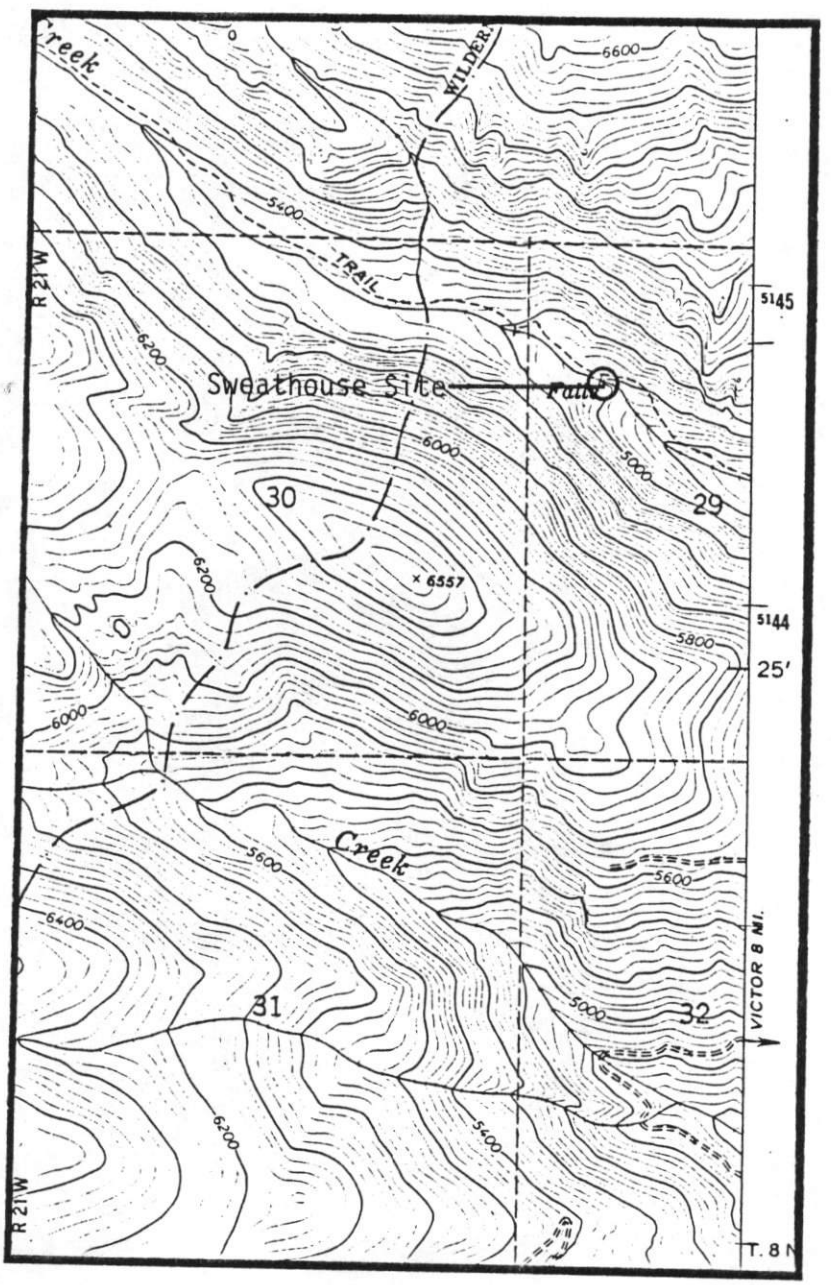


TROUT CREEK

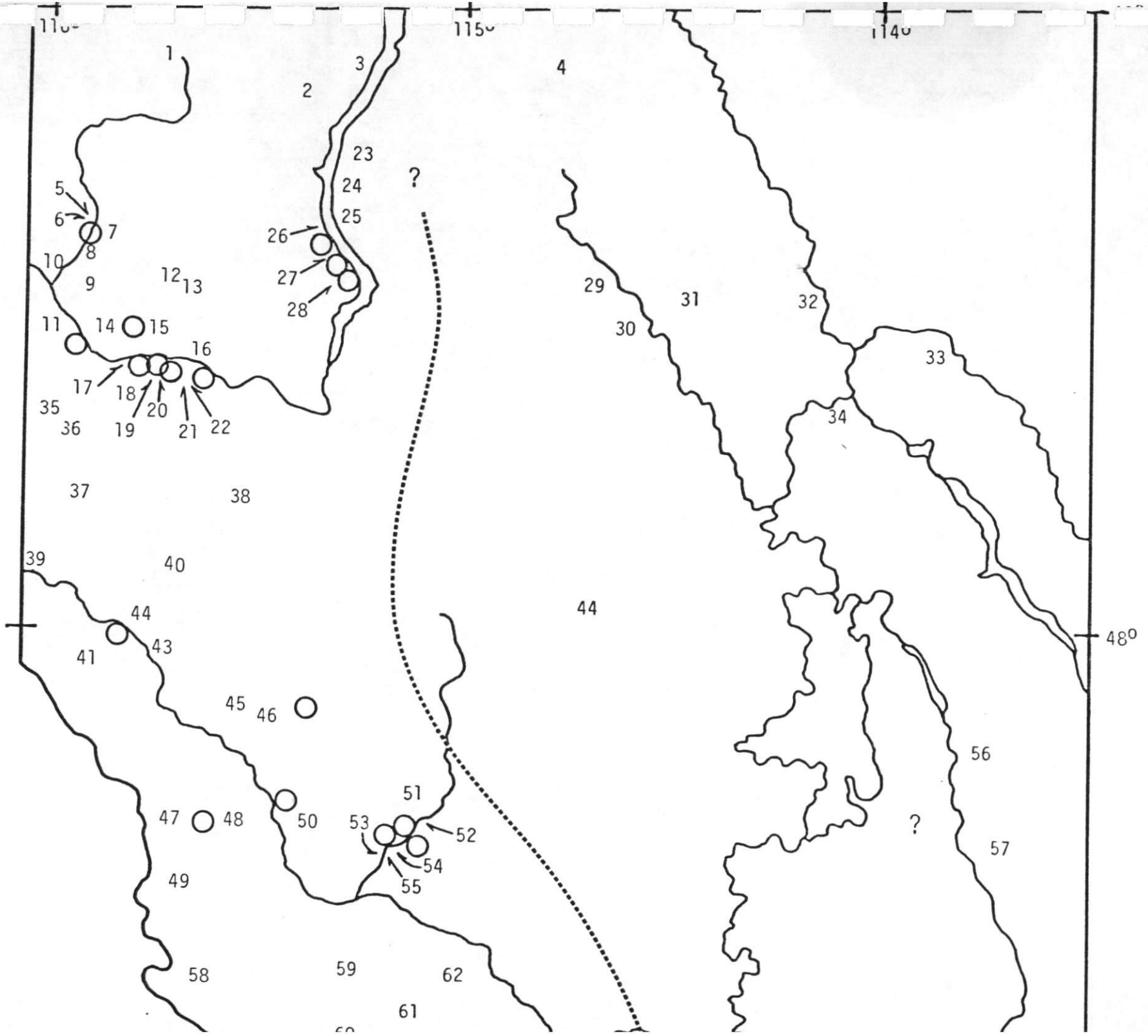
Map 17



Woodman Creek Site. Circles denote areas searched.



SWEATHOUSE SITE


115°
114°
48°
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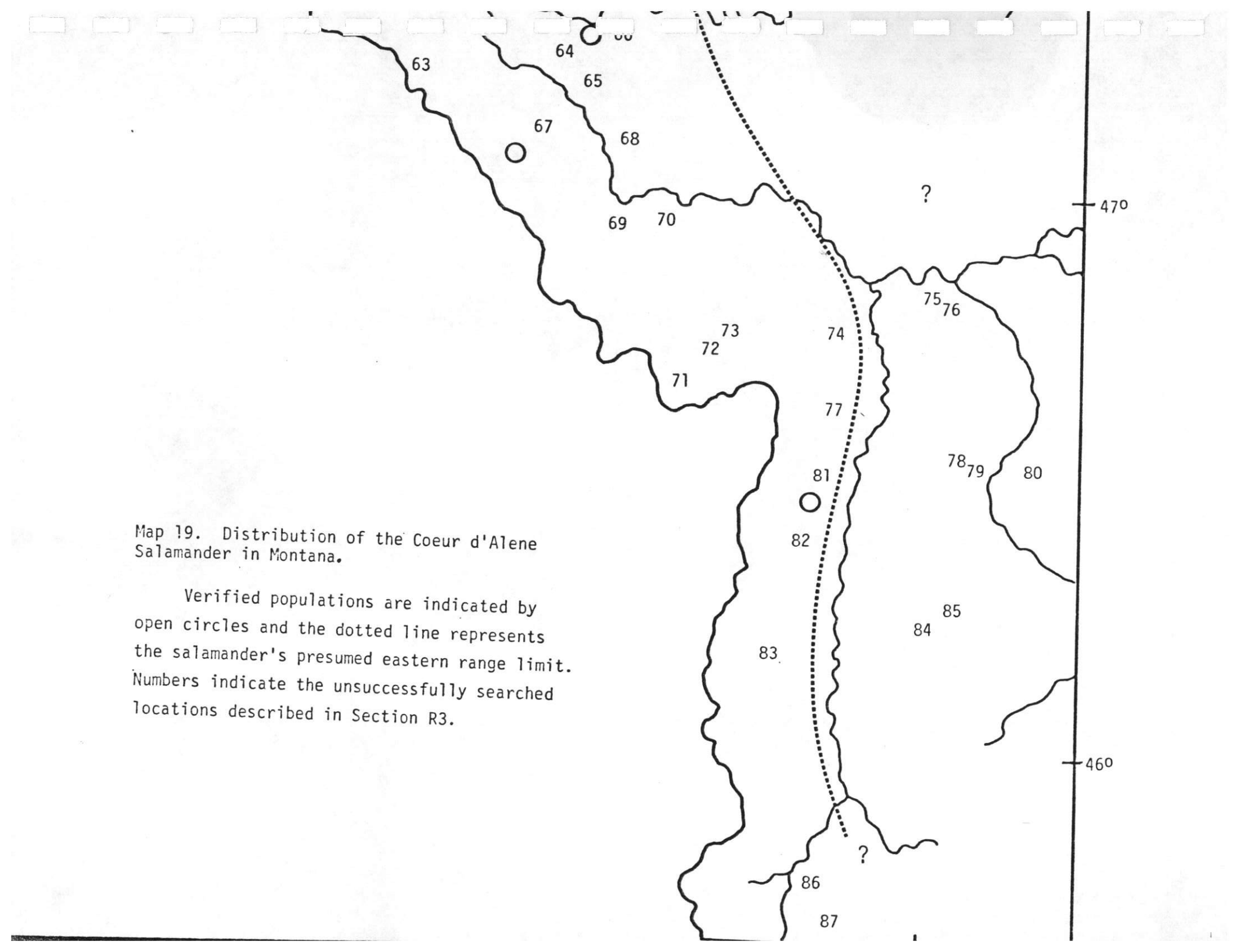
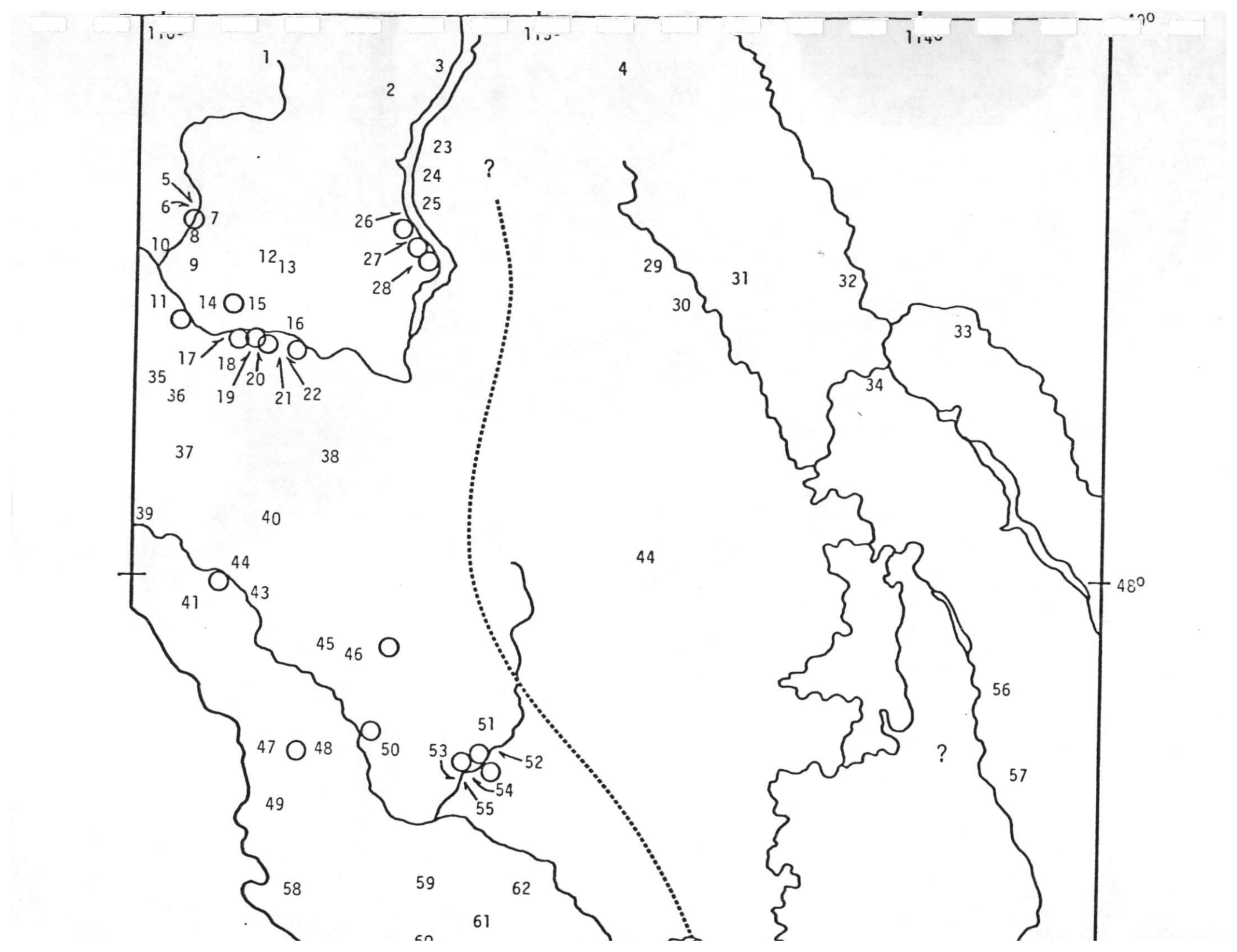


Map 19. Distribution of the Coeur d'Alene Salamander in Montana.

Verified populations are indicated by open circles and the dotted line represents the salamander's presumed eastern range limit. Numbers indicate the unsuccessfully searched locations described in Section R3.


1
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41
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46
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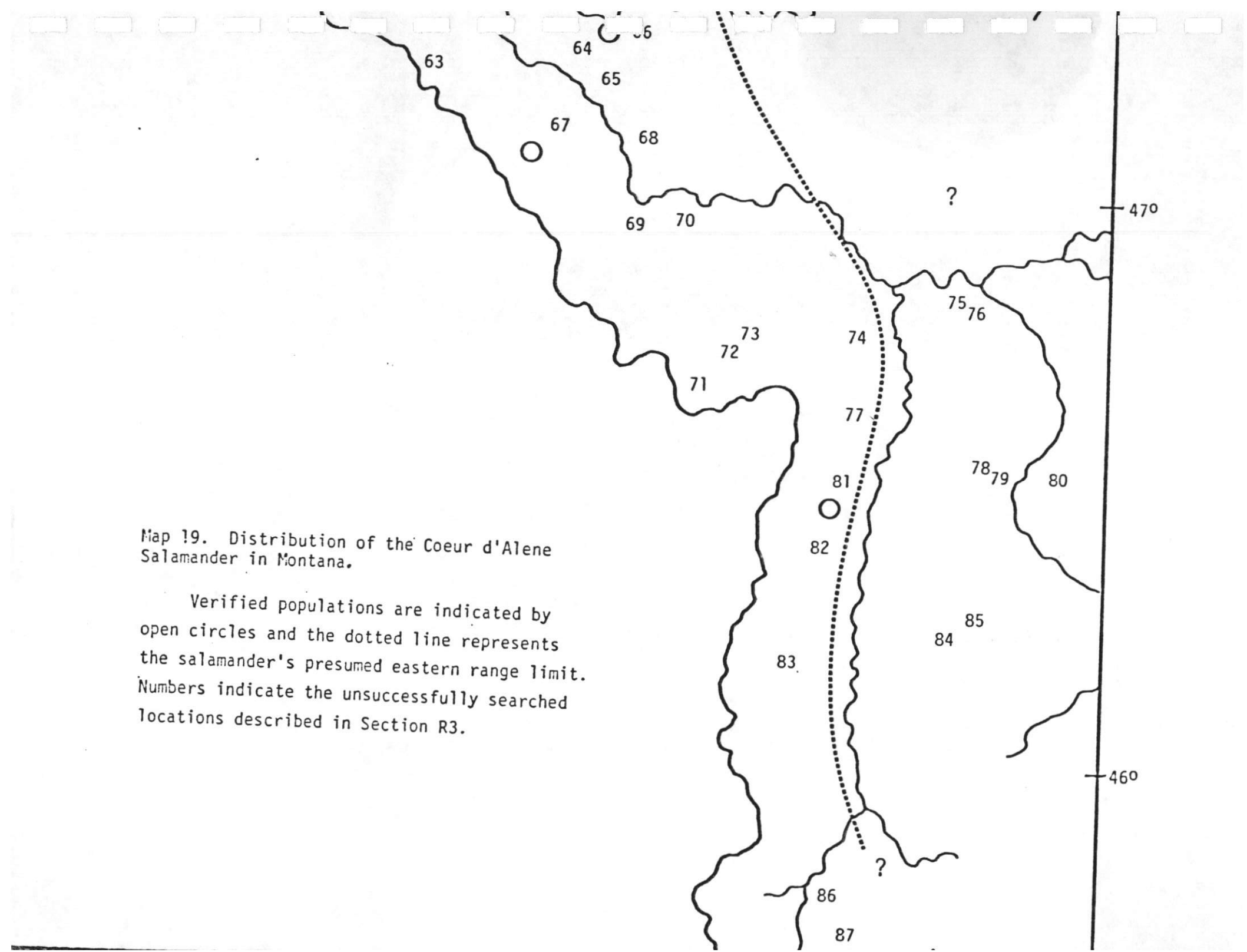
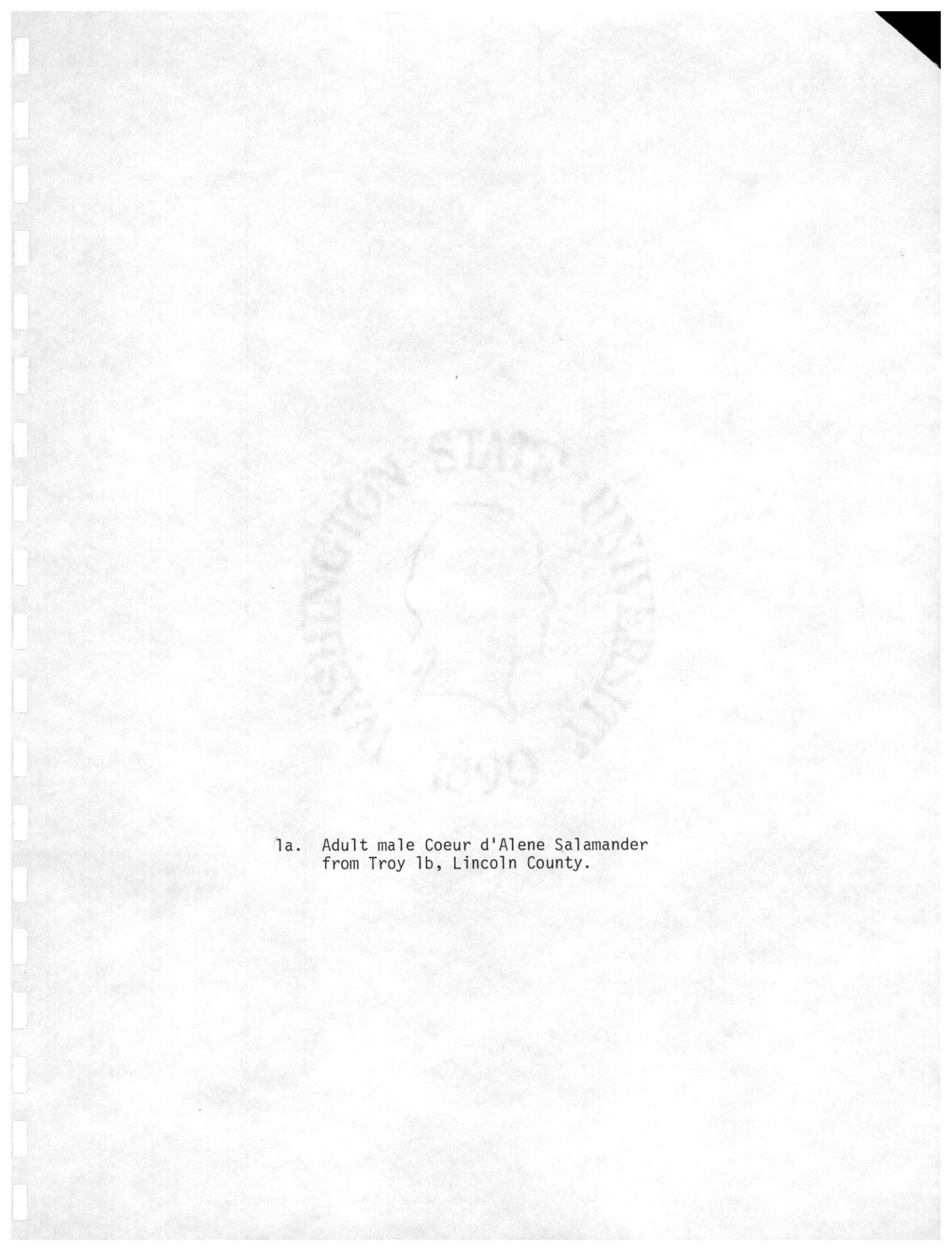
49
50
51
52
53
54
55
56
57
58
59
61
62
?
?
48°



Map 19. Distribution of the Coeur d'Alene Salamander in Montana.

Verified populations are indicated by open circles and the dotted line represents the salamander's presumed eastern range limit. Numbers indicate the unsuccessfully searched locations described in Section R3.

Photo Contents	
Figure #	Location
1a	Male PLID (photo missing?)
2 a & b	Troy 2
3 a & b	Teberg's Sites
4, 5a	Teberg's Sites - Troy 1a & 1b
5 b & c	Teberg's Sites - Troy 1b & 1b
5 d & e	Teberg's Sites - Troy 1b & 1b
6, 7a	Teberg's Sites - Troy 1c & 1d
7 b & c	Teberg's Sites - Troy ld
8	Teberg's Sites - Troy le
9 a & b	Troy 3 Site
10 a & b	Troy 5 Site
11 a & b	North Troy 1
12	Keeler Creek
13 a & b	Surprise Gulch
13 c & d	Surprise Gulch
14 a, b & c	Yaak Falls
15 a & b	Big Hoodoo Mountain
16 a & b	Koocanusa 1
17 a & b	Koocanusa 2a
18 a & b	Koocanusa 2b
19 a & b	Koocanusa 2c
20 a & b	Koocanusa 3
21 a, b & c	Noxon
22 a & b	Thompson River
23 a & b	Thompson River 1a
24	Thompson River 1b
25 a & b	Priscilla Gulch
26 a & b	Barktable Creek
27 a & b	Sims Creek
28 a & b	Cougar Gulch
29 a, b & c	Big Beaver Creek
30 a, b & c	Cascade Creek
30 d & e	Cascade Creek
31 a & b	Trout Creek
31 d & c	Trout Creek
32	Sweathouse

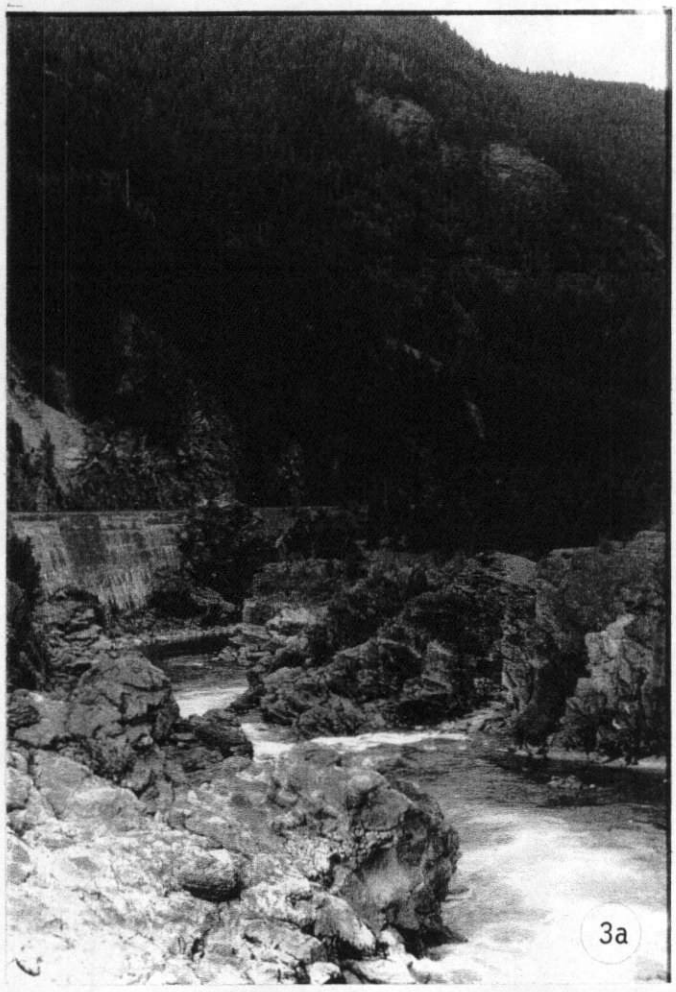


1a. Adult male Coeur d'Alene Salamander from Troy 1b, Lincoln County.

2a. Above road, view to southeast.

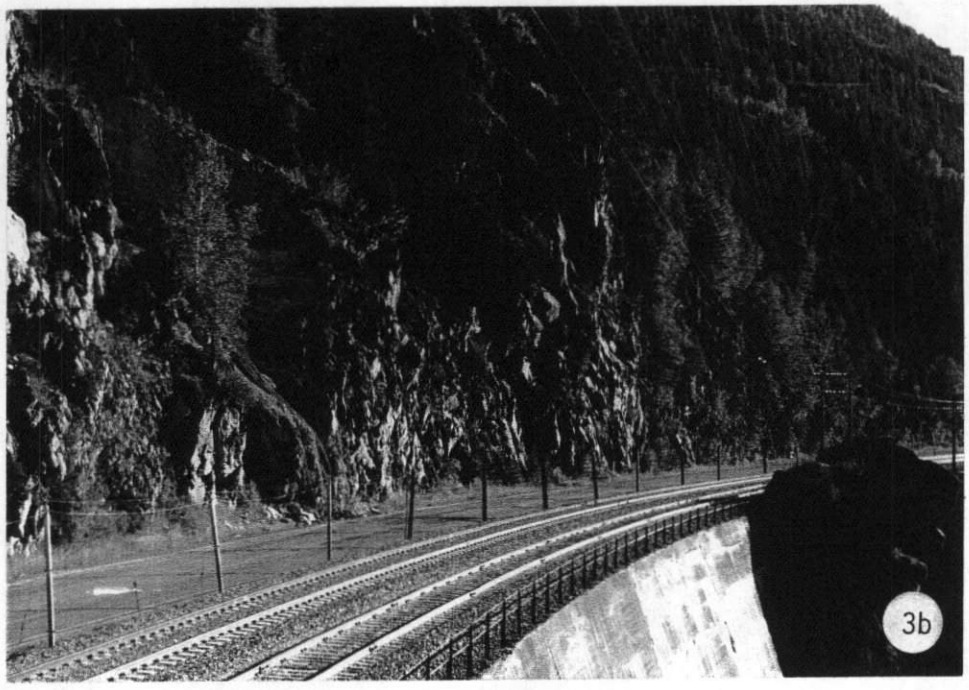
2b. Below road, view to south.

Teberg's Sites



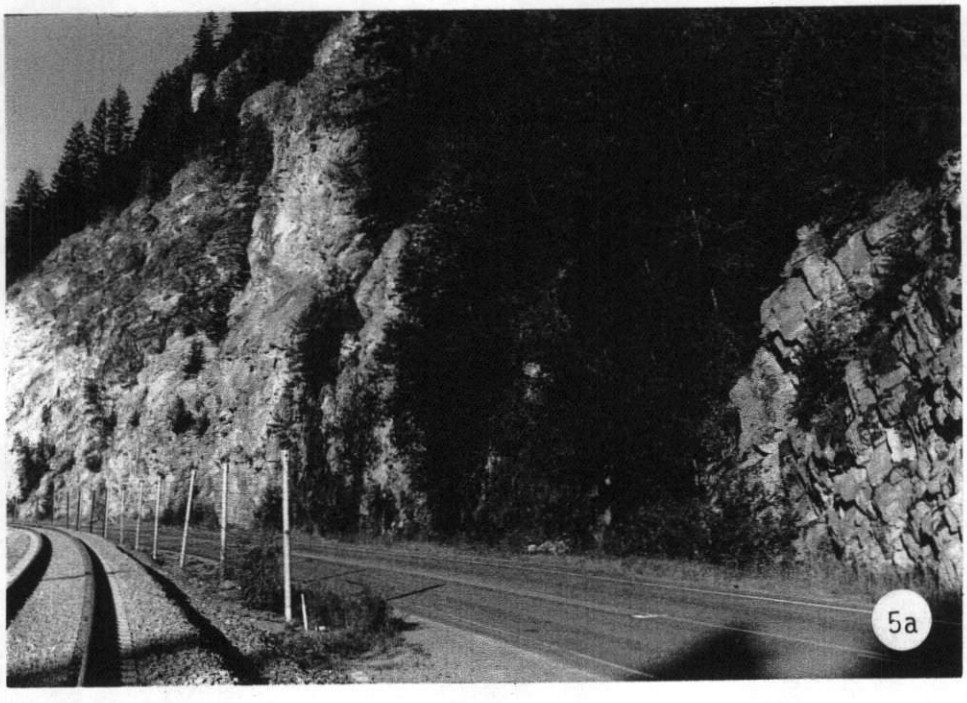
3a. View to south. southwest

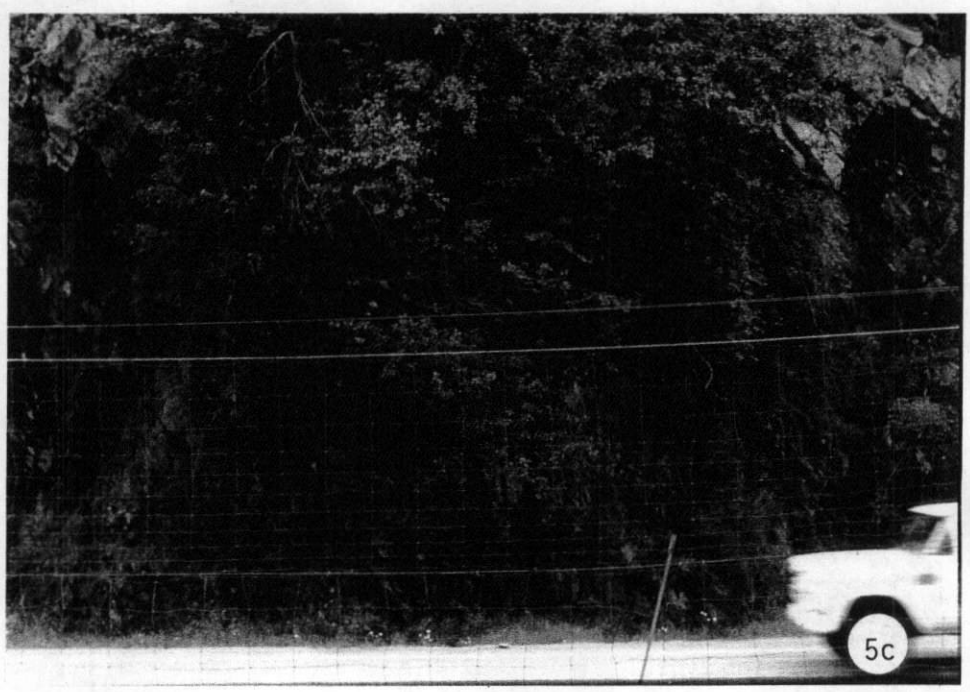
3b. View to west.



4. Troy 1a, view to south.

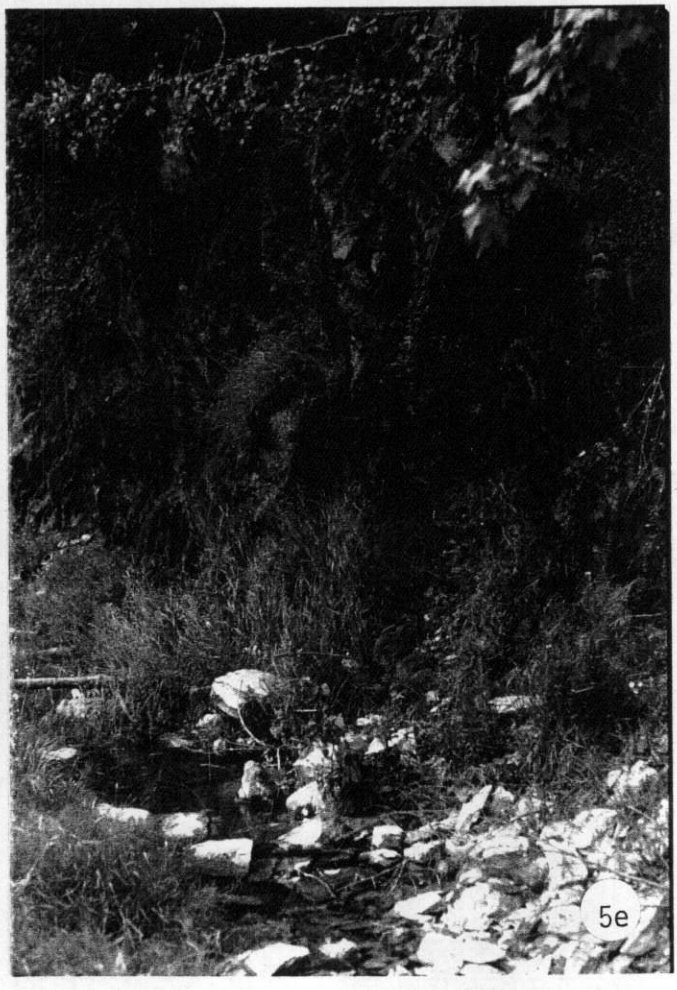
5a. Troy 1b, view to southeast.





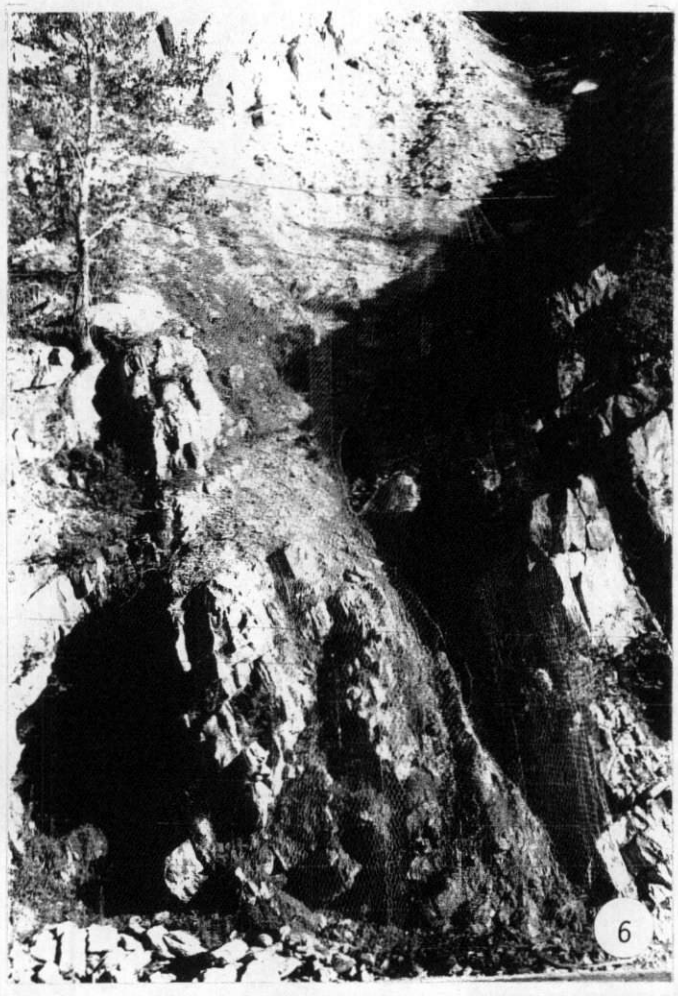
5b. Troy 1b; west seepage, view to south.

5c. Troy 1b; middle seepage, view to south.



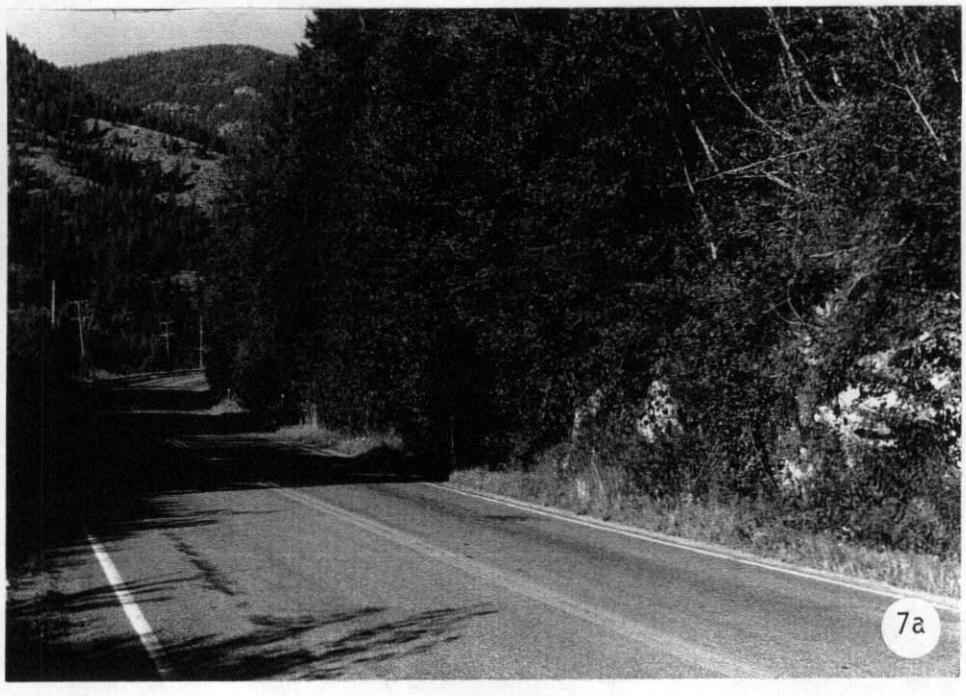
5d. Troy 1b; east seepage, view to south.

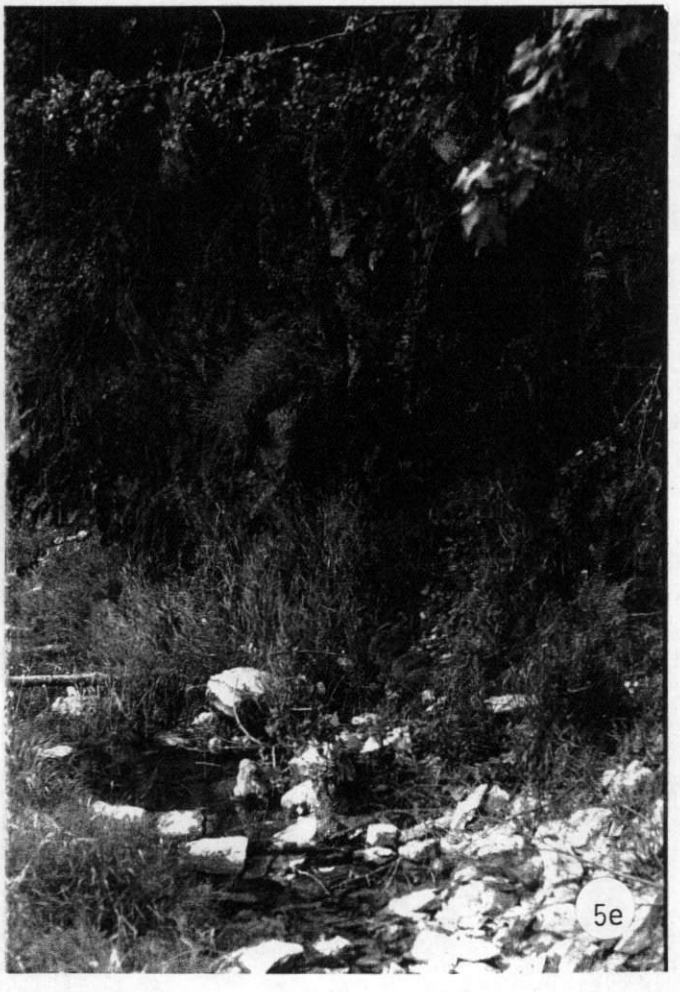
5e. Troy 1b; middle seepage, view to east.



6. Troy 1c, view to south.

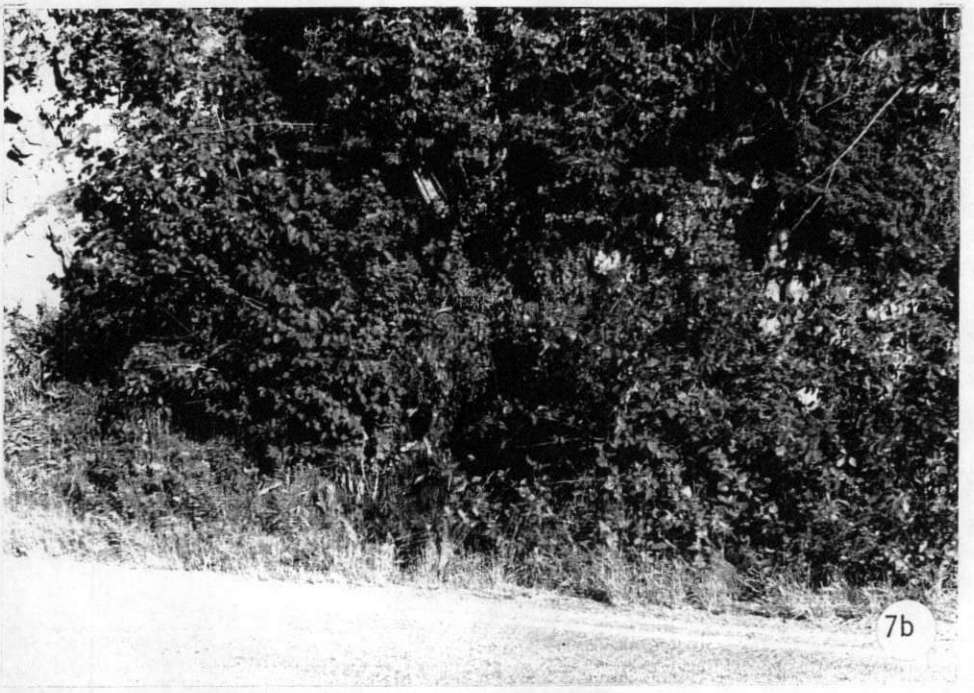
7a. Troy 1d, view to east.

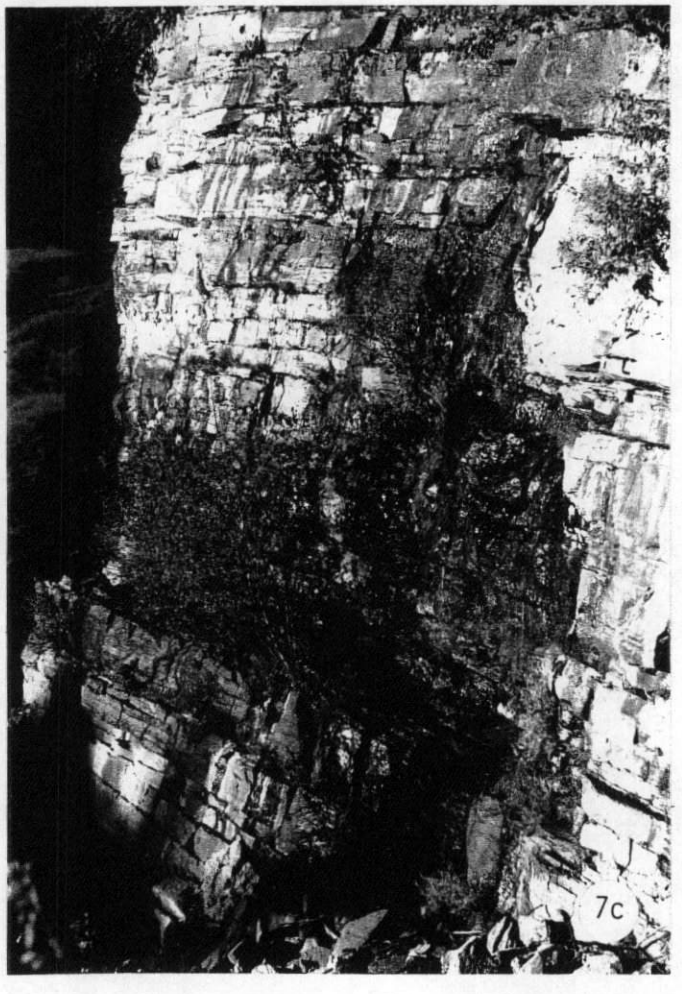




5d. Troy 1b; east seepage, view to south.

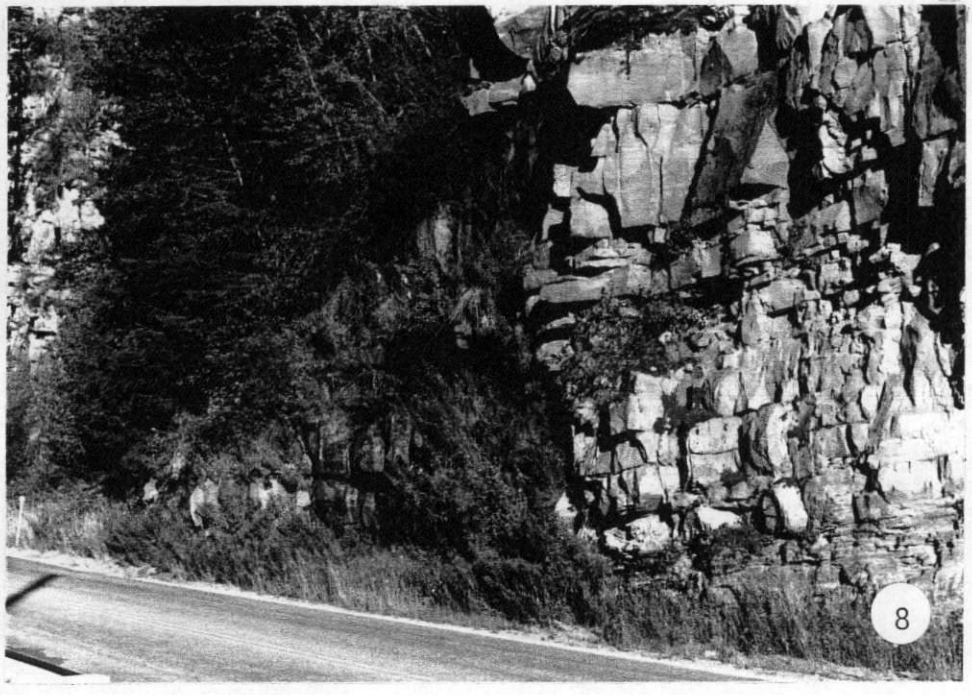
5e. Troy 1b; middle seepage, view to east.



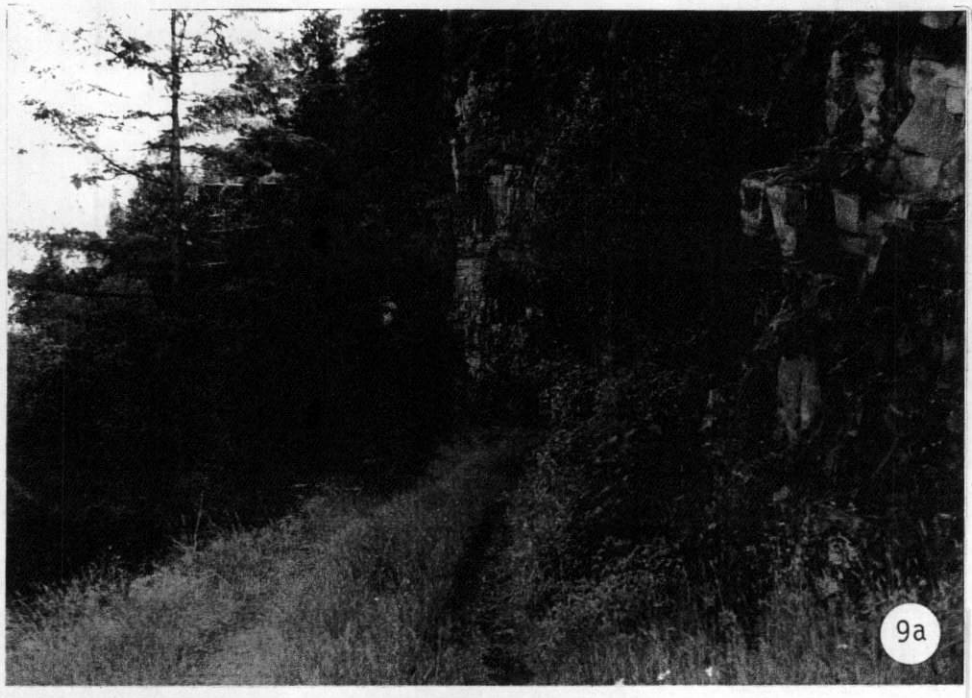


7b. Troy ld; above road, view to south.

7c. Troy ld; above road, view to northeast.

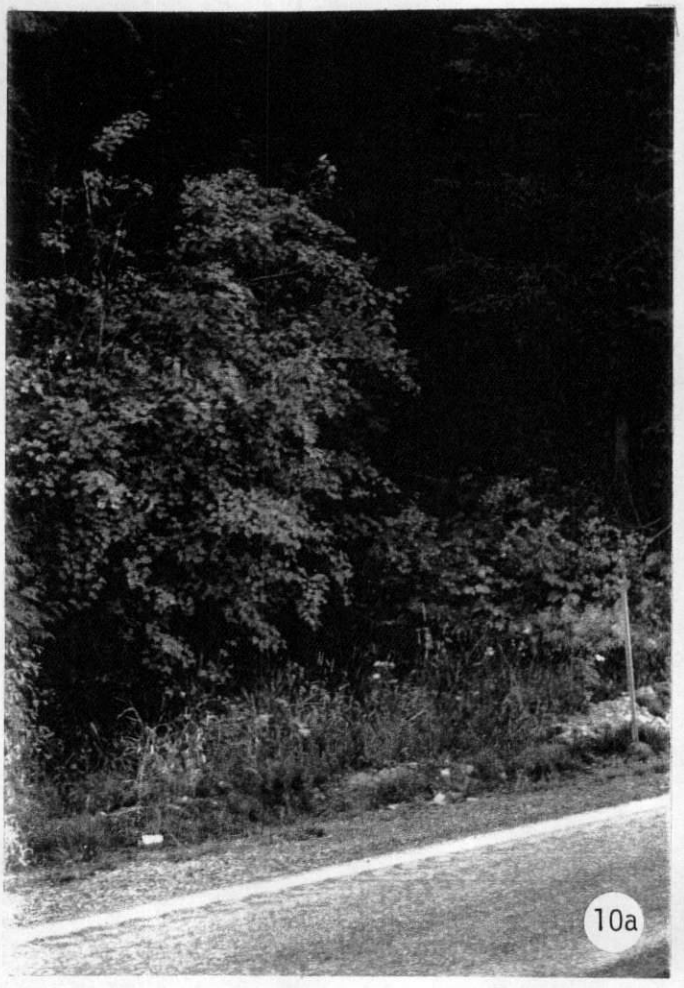


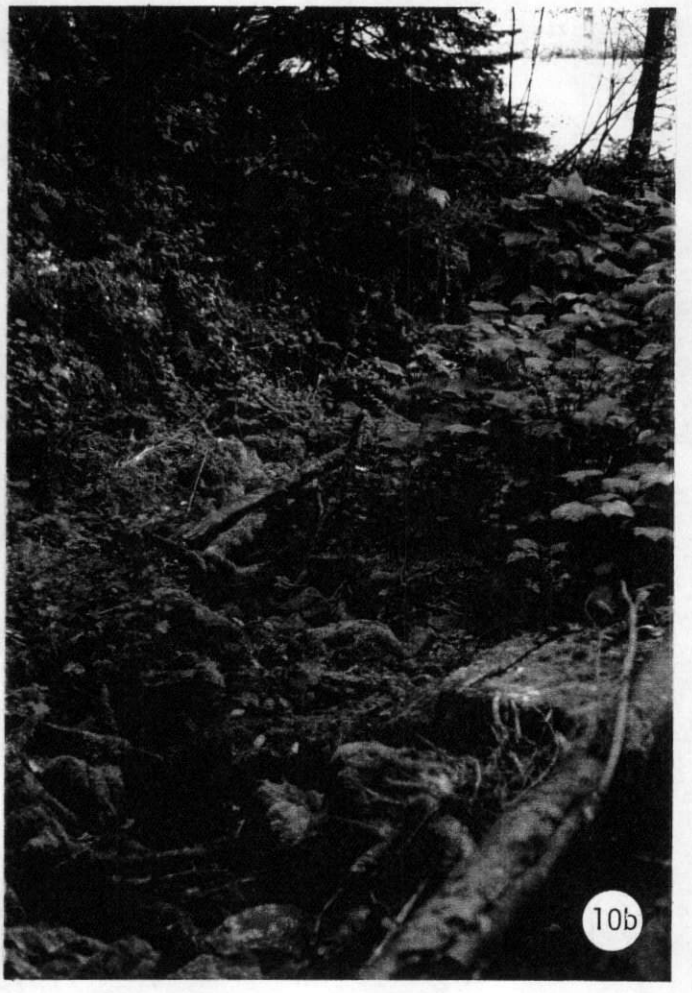
8. Troy le, view to southeast.



9a. View to east.

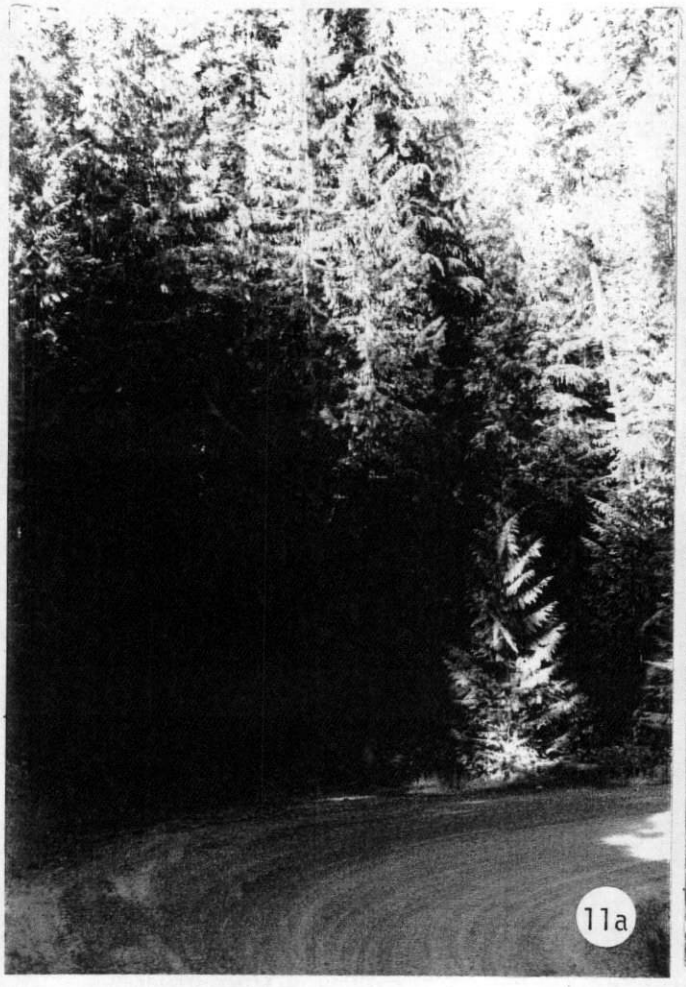
9b. Capture site, view to south.

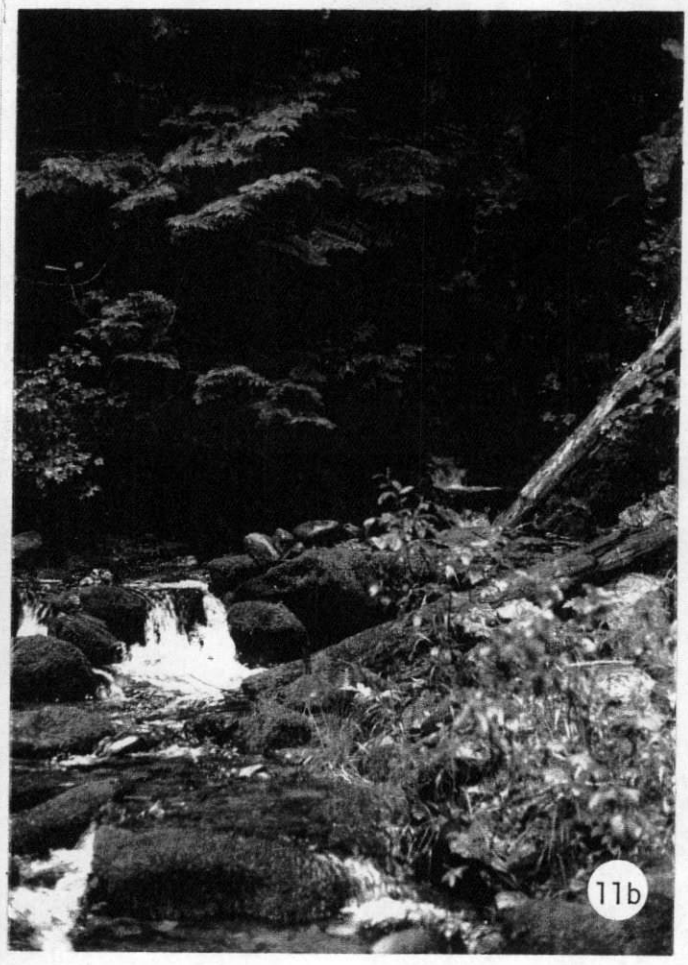




10a. View to southwest.

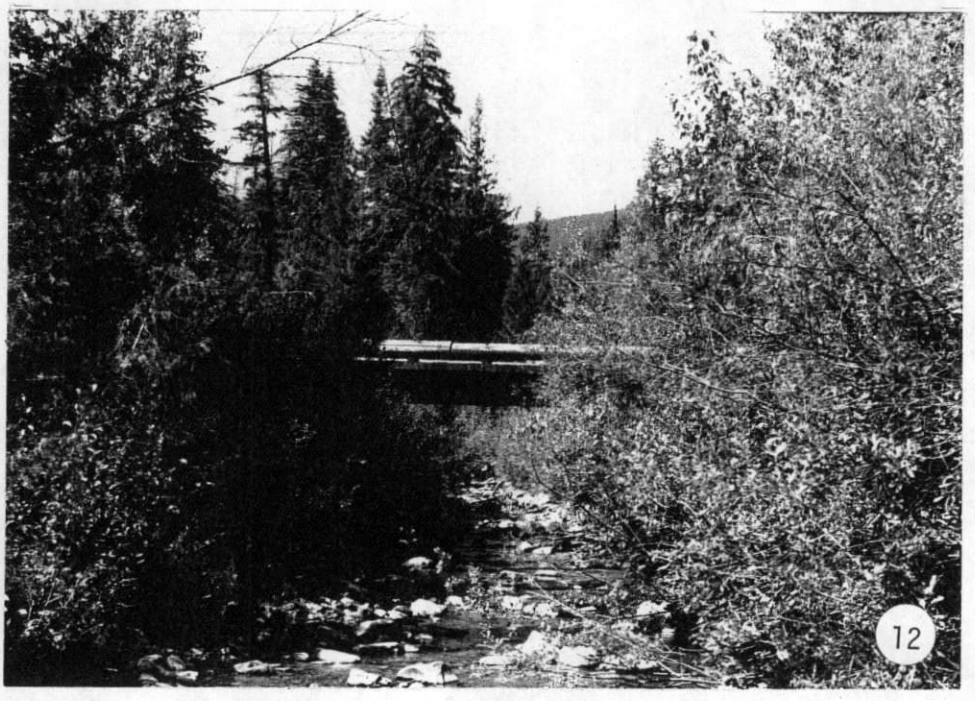
10b. View to north.





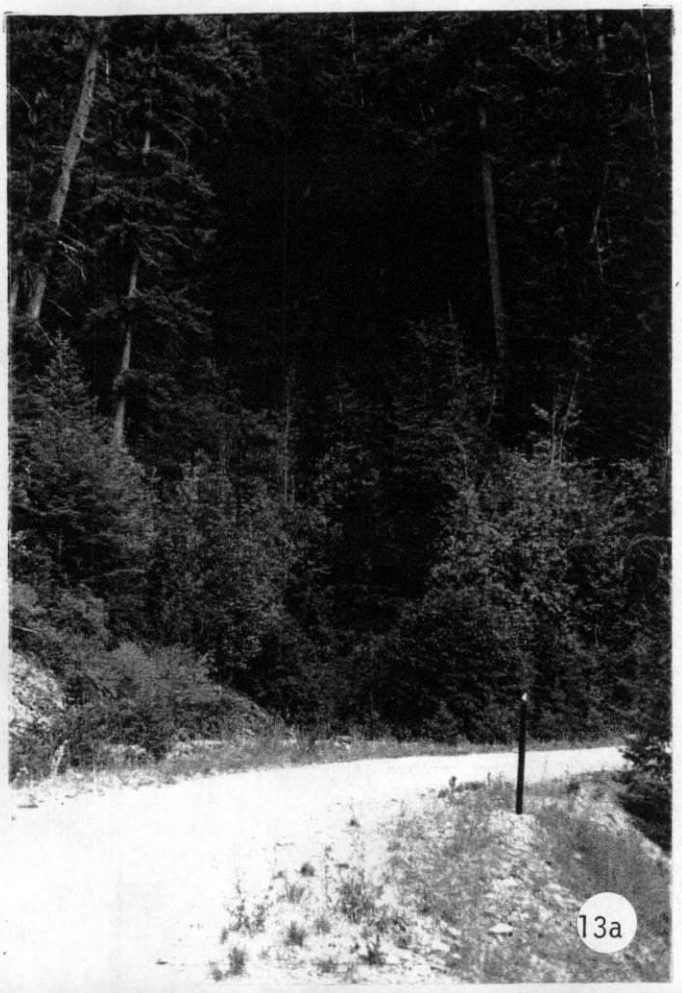
11a. View to south.

11b. Capture site,
view to south.



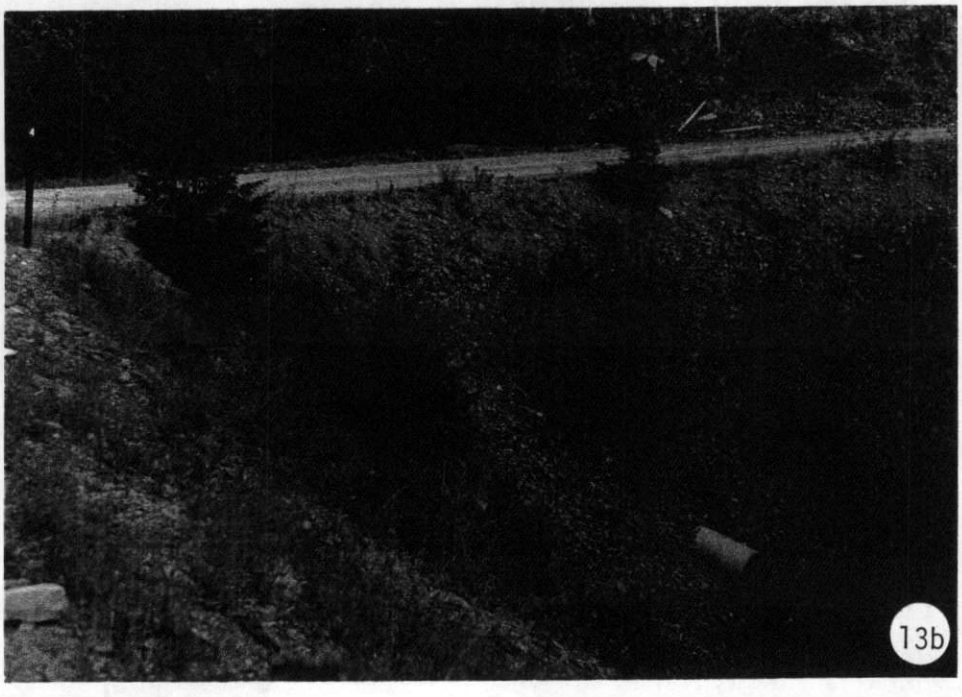
12. View to north.

Surprise Gulch



13a. Above road, view to east.

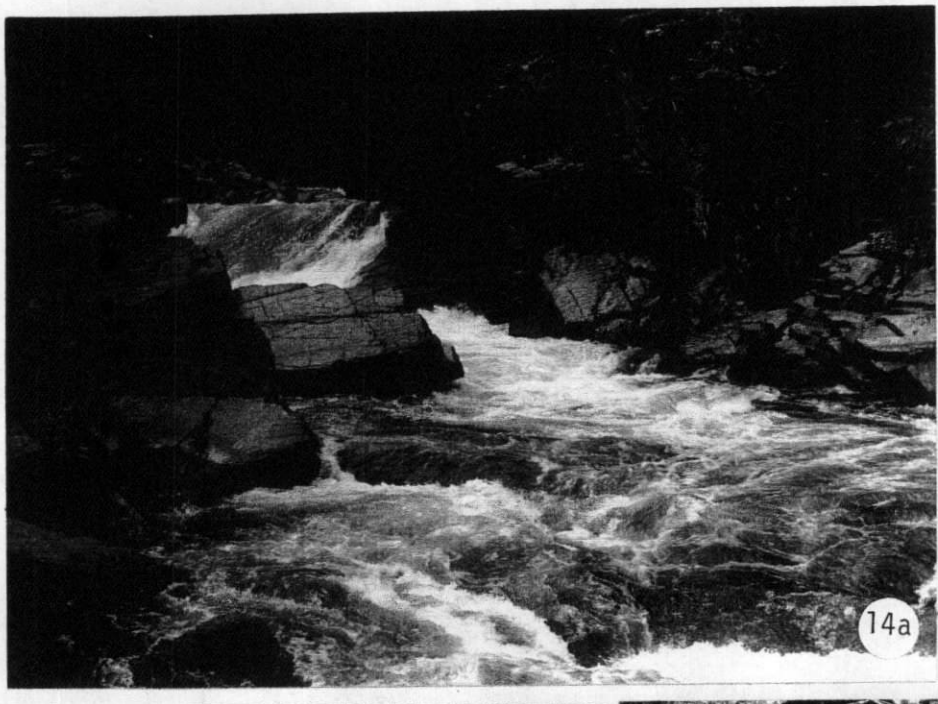
13b. Below road, view to east.



13c. Above road, view to northeast.

13d. Below road, view to southwest.

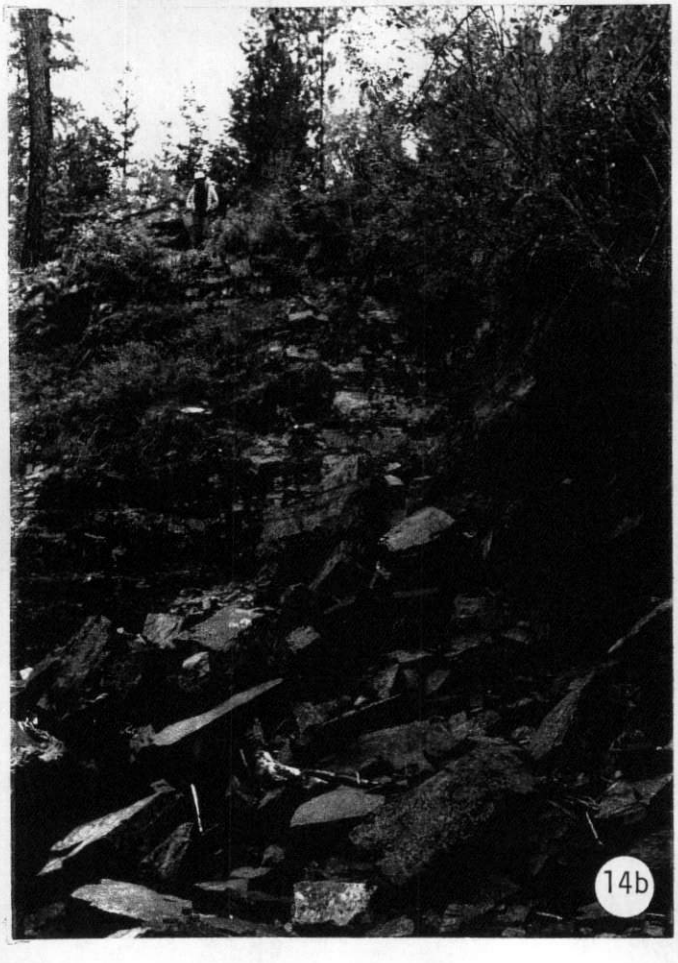
Yaak Falls

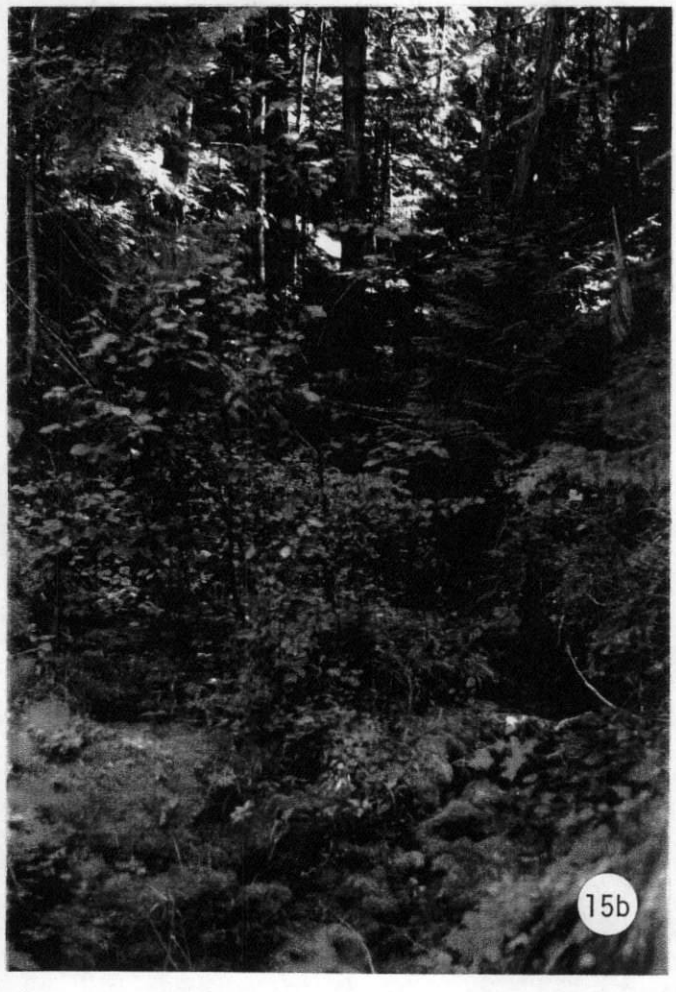


14a. View to north.

14b. Downstream capture site, view to south.

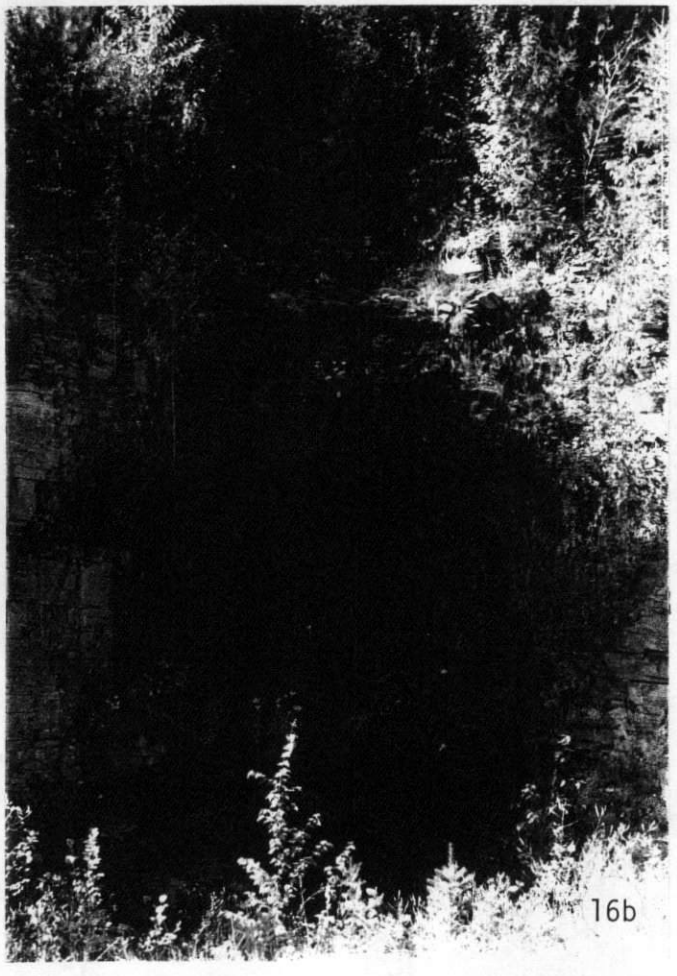
14c. Upstream capture site, view to west.





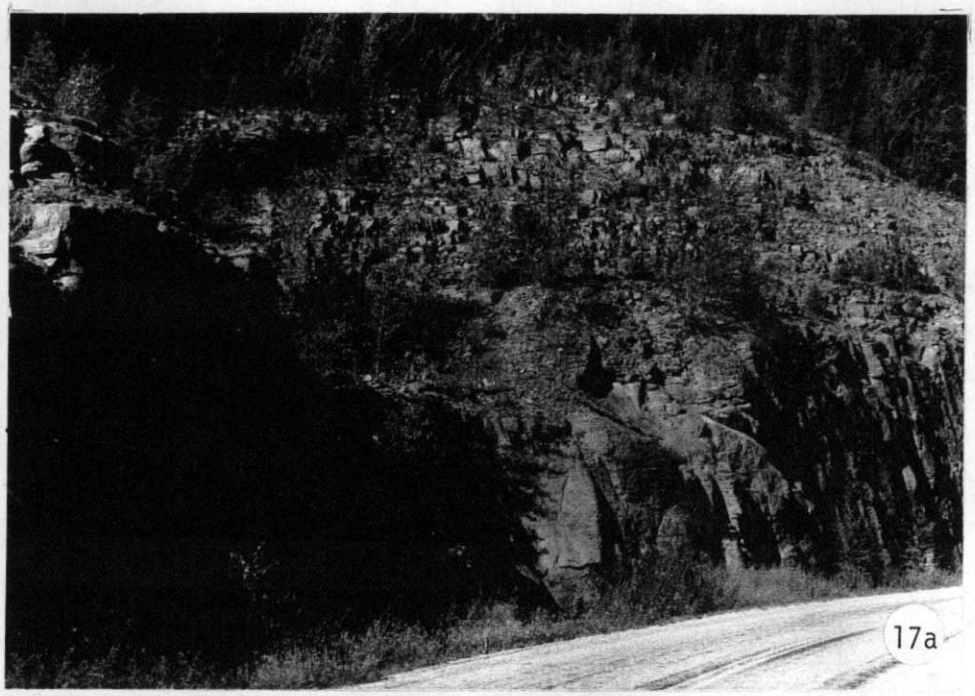
15a. Historic site, view to south.

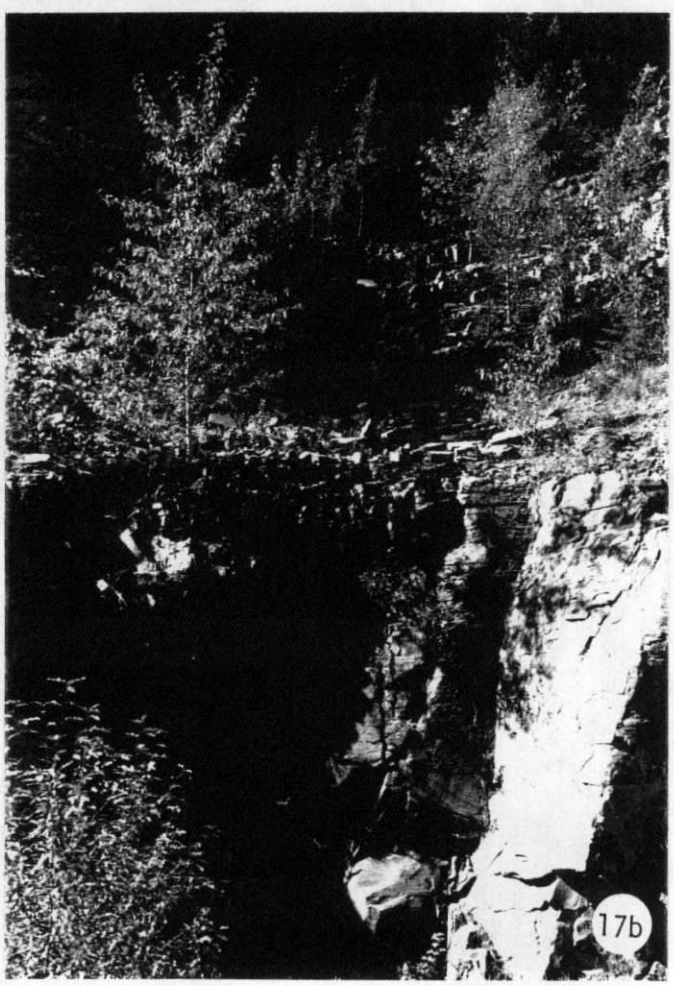
15b. Historic site, view to southeast.



16a. View to west.

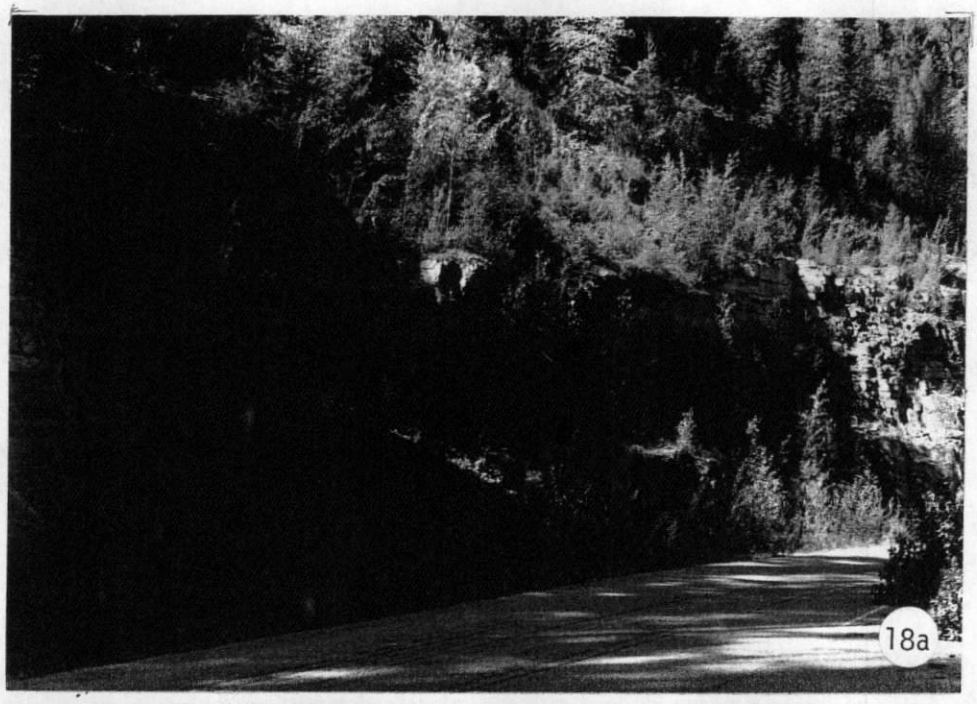
16b. View to southwest.

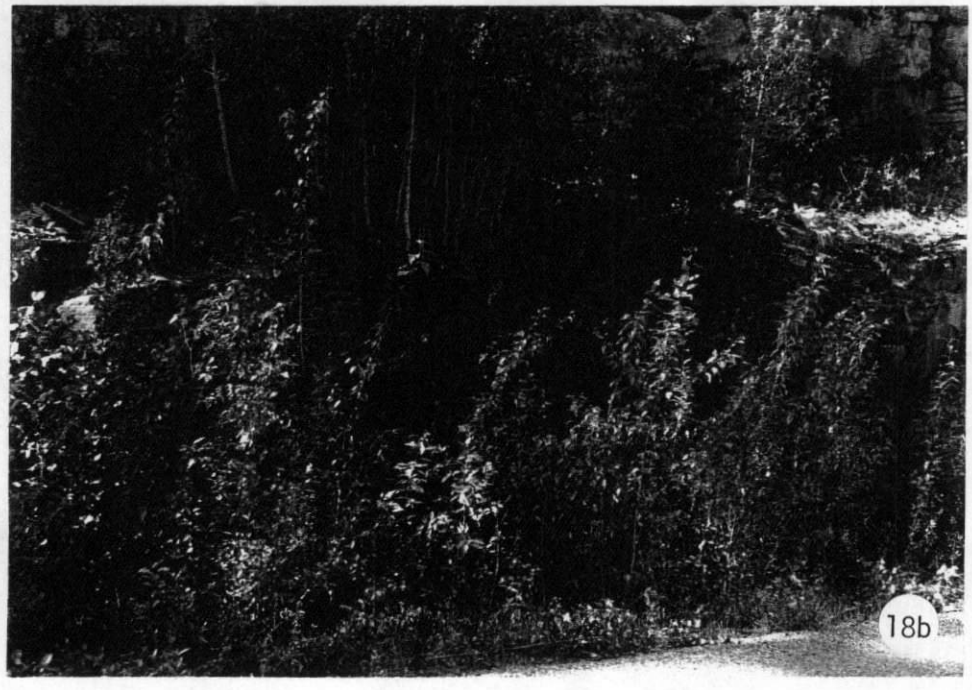




17a. View to west.

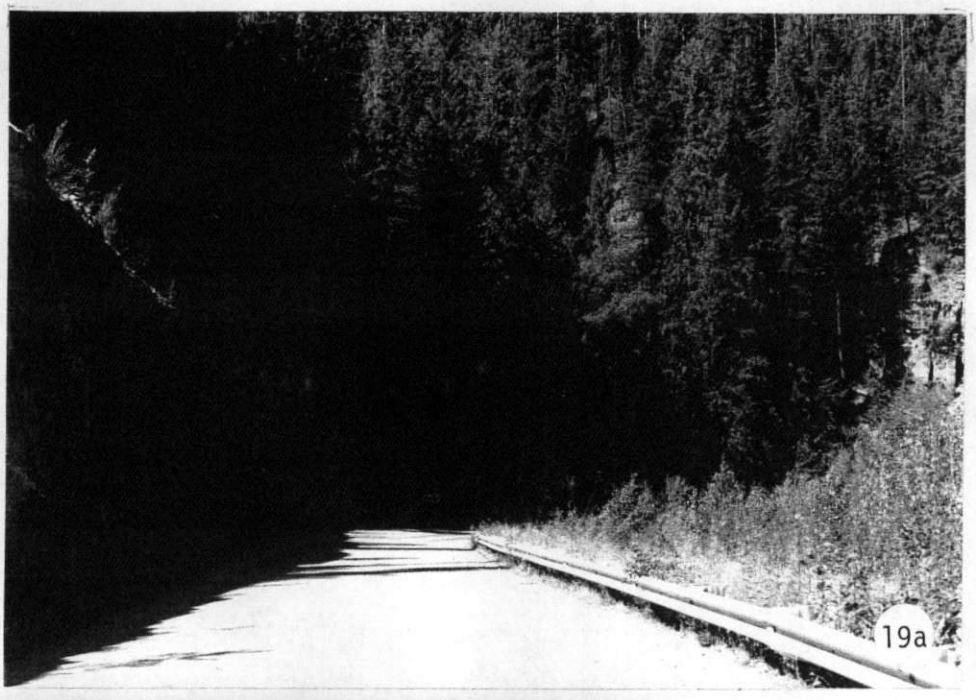
17b. View to southwest.





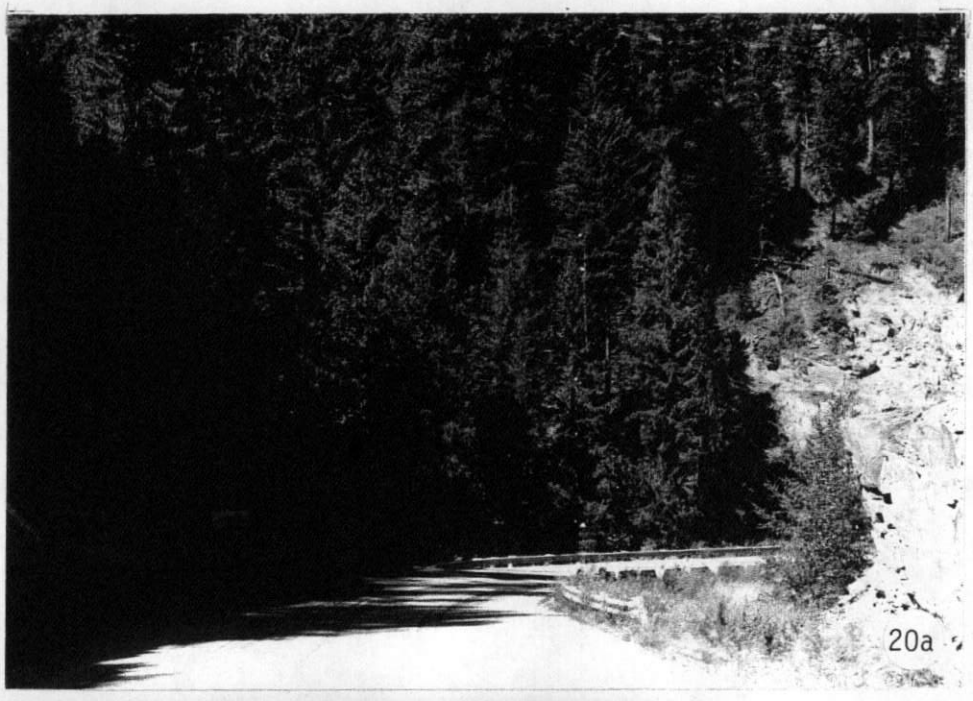
18a. View to west.

18b. View to west.



19a. View to southwest.

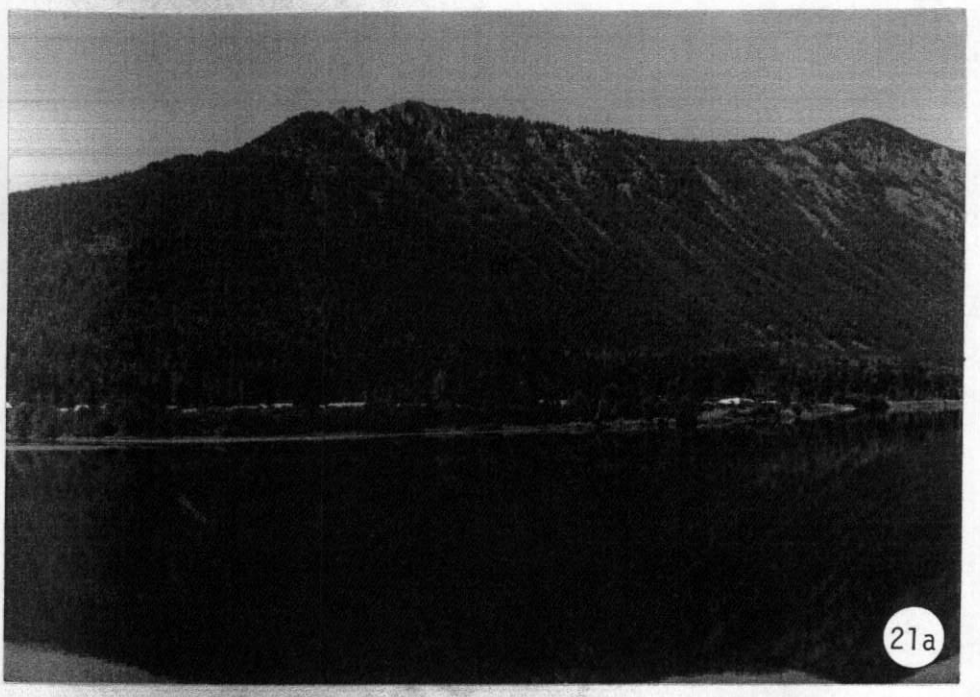
19b. View to southwest.



20a. View to west.

20b. View to southwest.

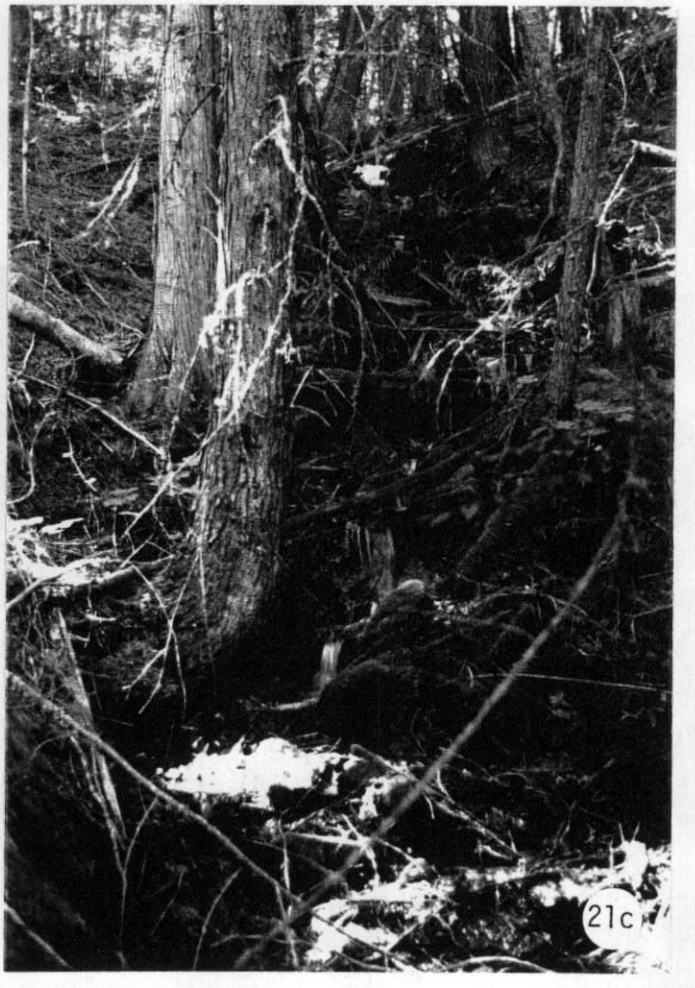
Noxon

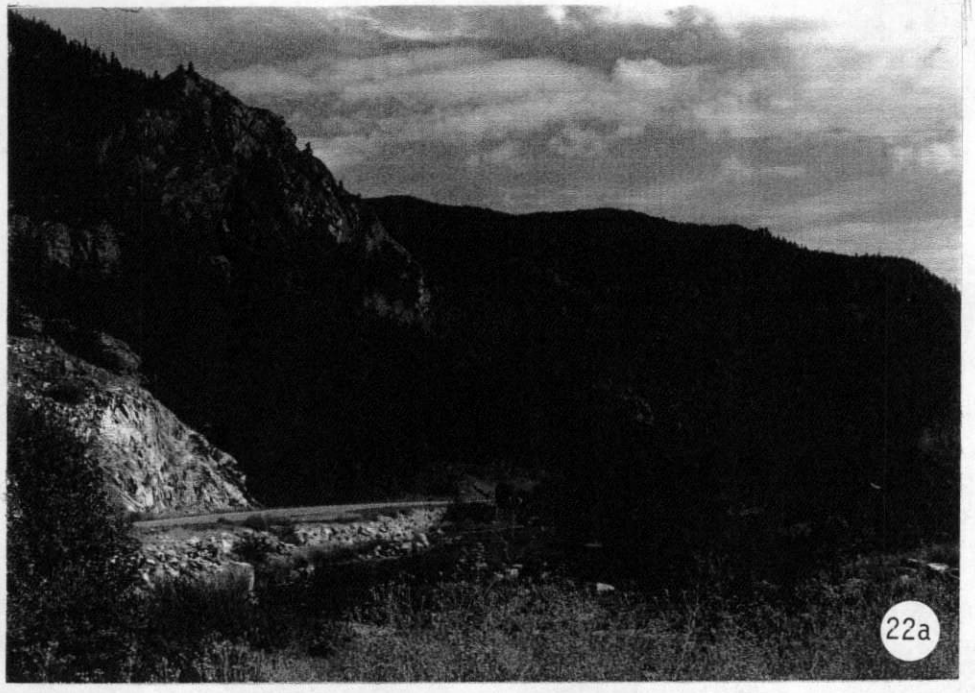


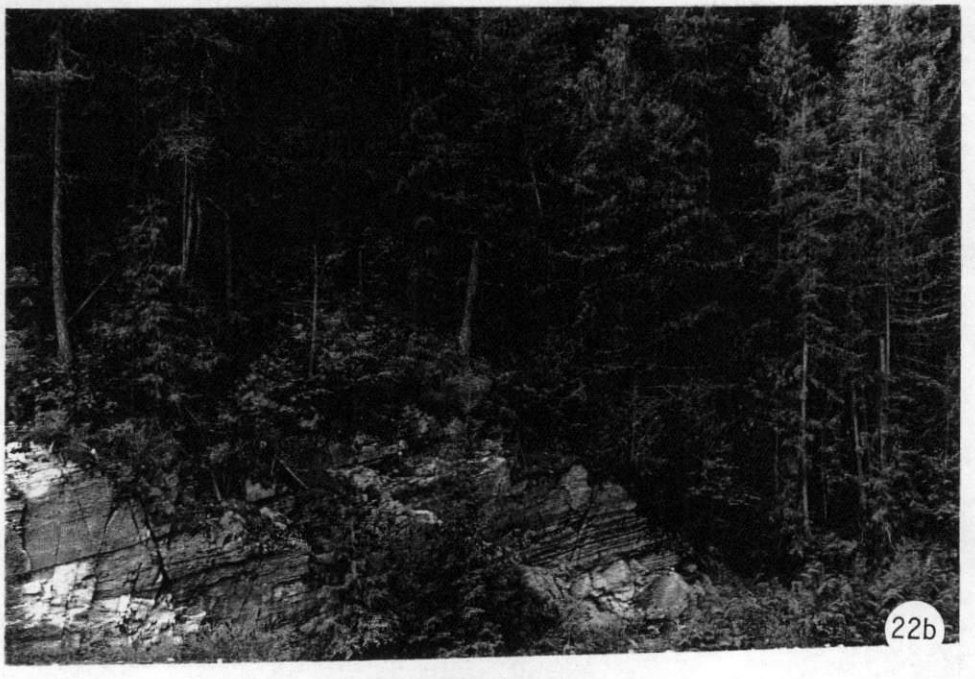
21a. View to west.

21b. View to south from roadside.

21c. View to south.







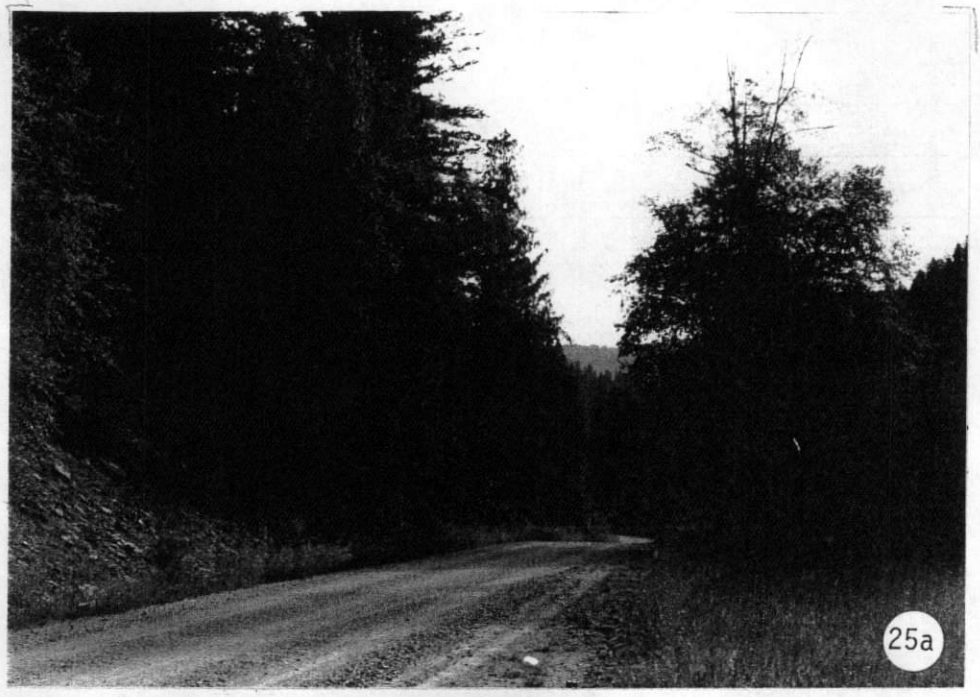
22a. View to north.

22b. View to west.

23a. View to northwest; southern seepage.

23b. View to northwest; northern seepage.

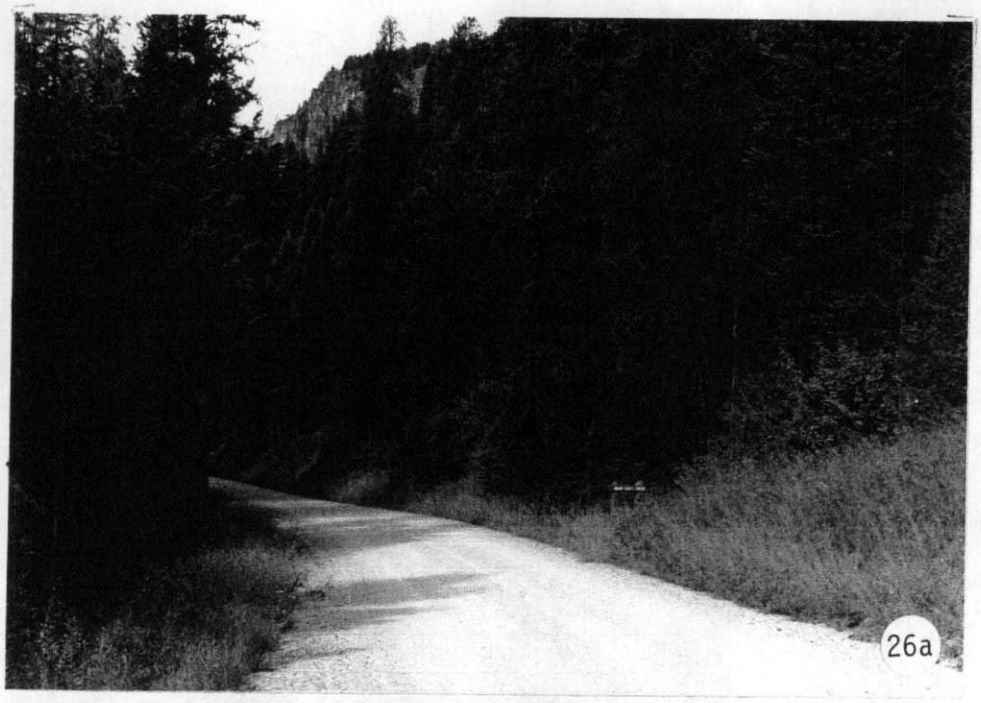
24. View to northeast.



These seem switched around.

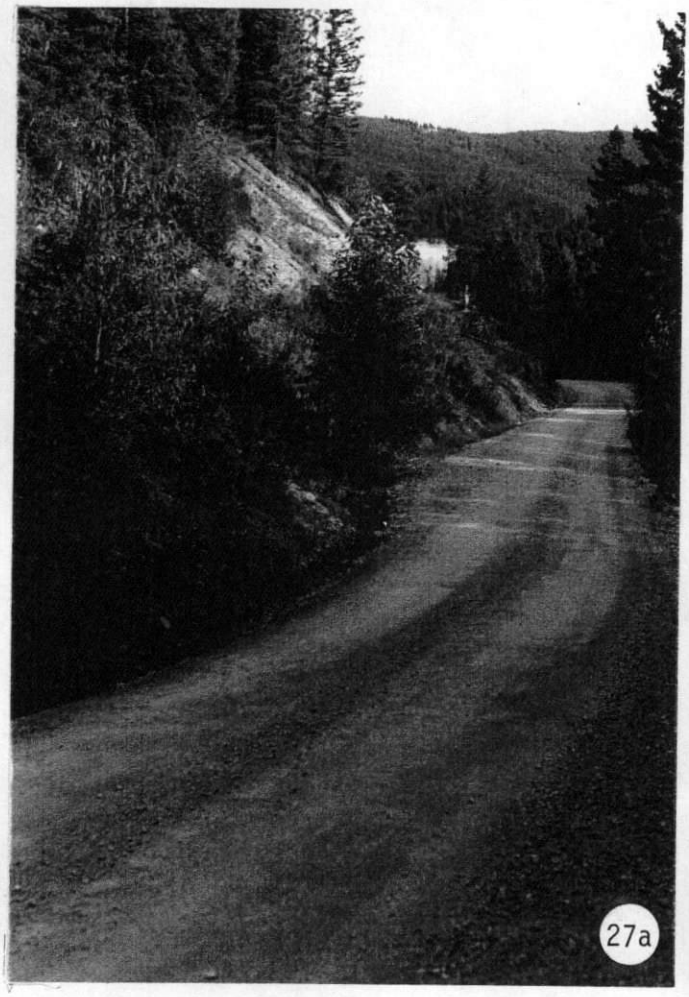
25a. View to northwest.

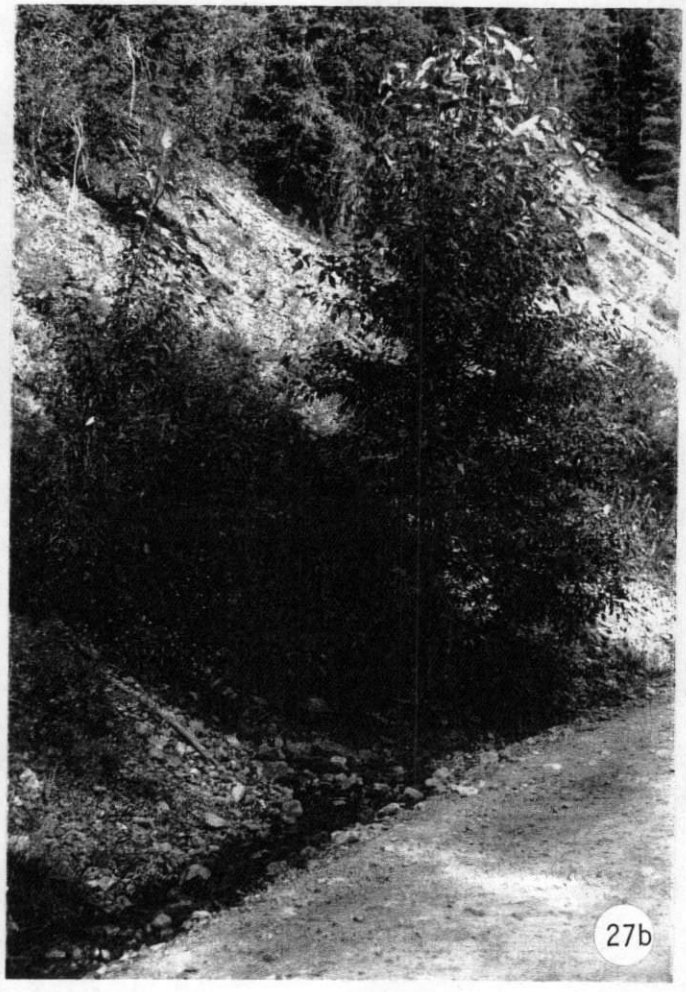
25b. View to north.



26a. View to west.

26b. View to northwest.

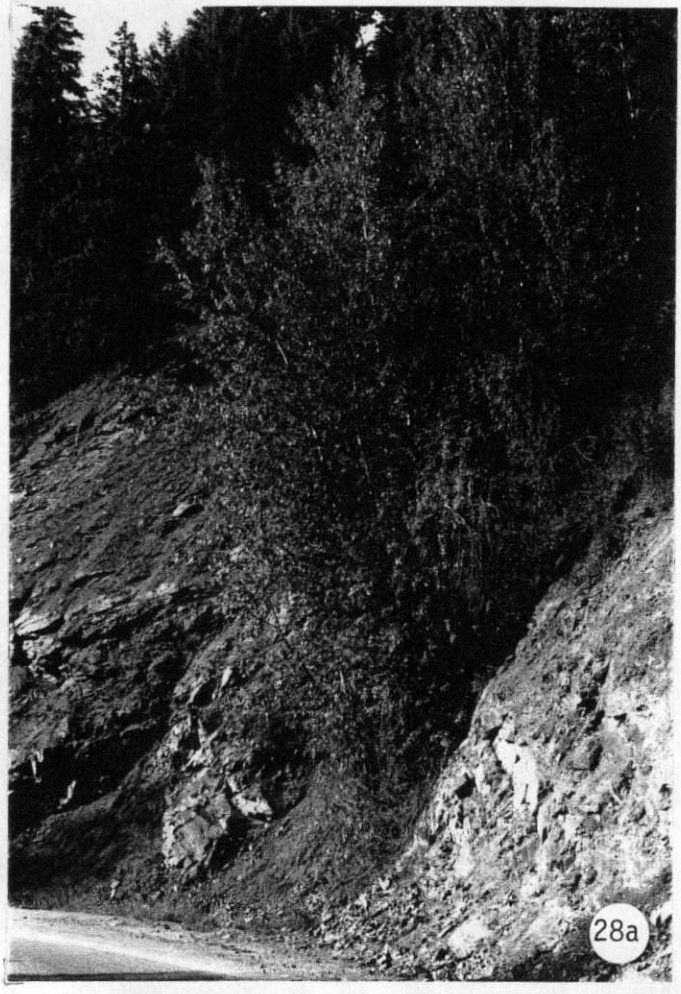




27a. View to southeast.

27b. Spring source,
view to east.

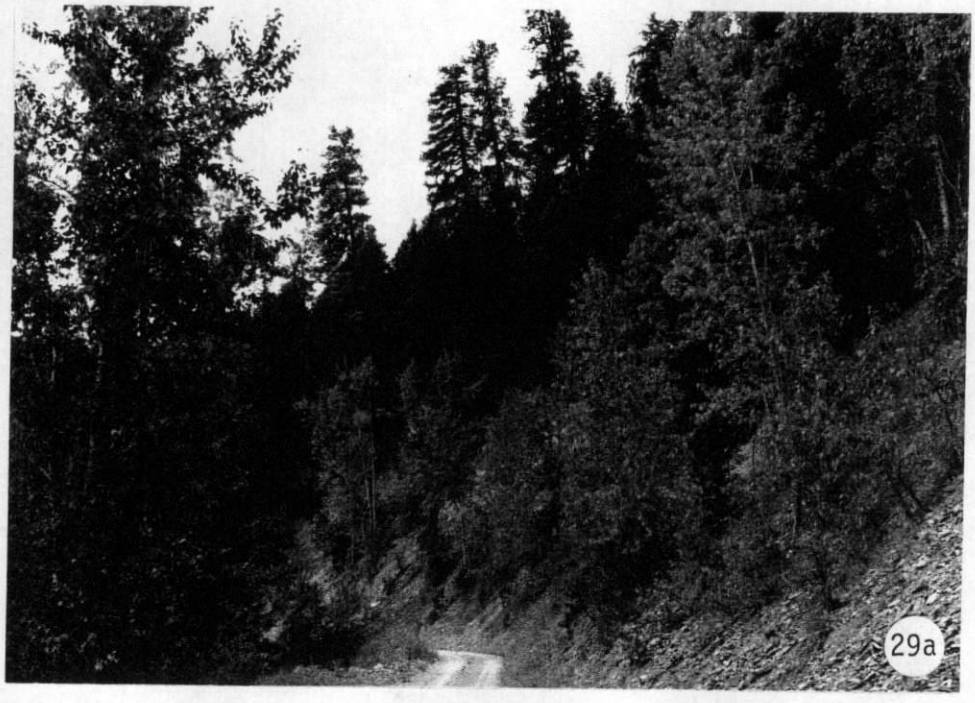
Cougar Gulch



28a. View to north.

28b. View to northeast.

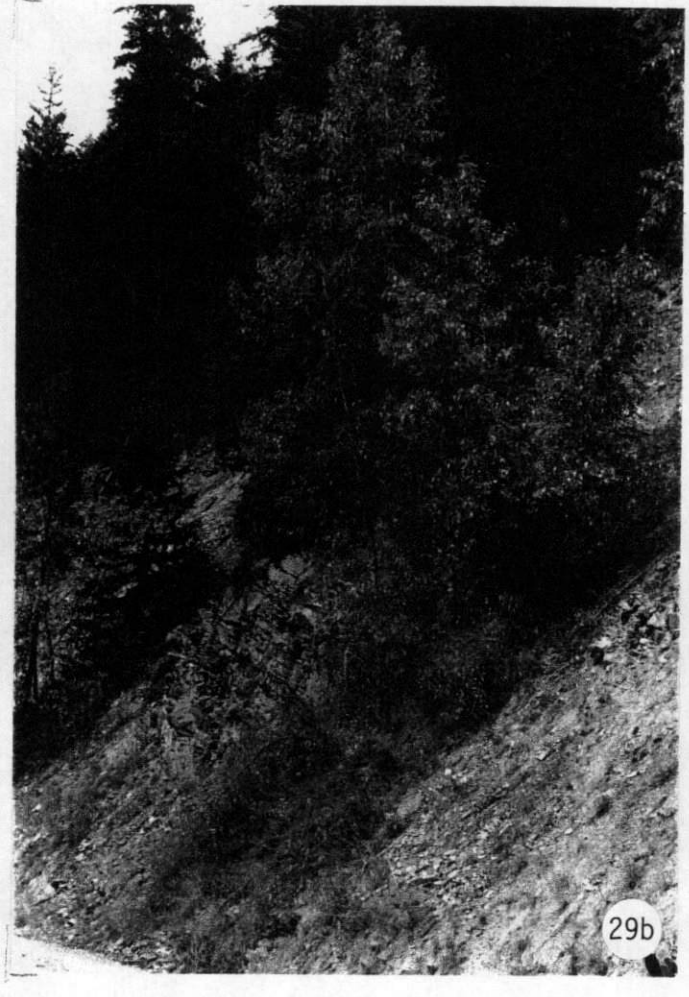
Big Beaver Creek



29a. View to west.

29b. View to west.

29c. View to north.

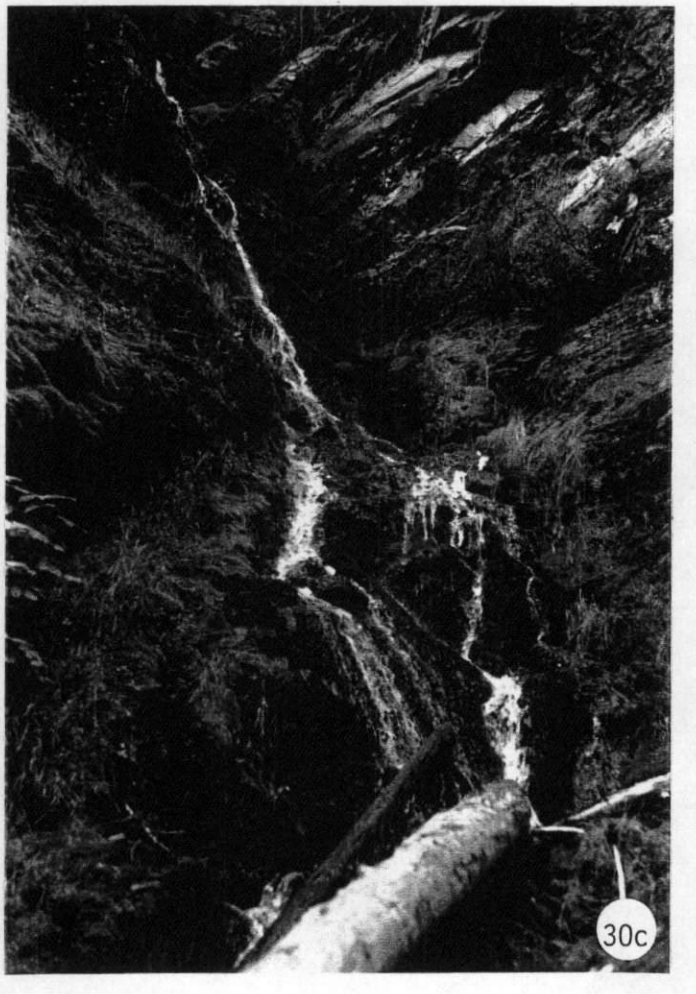


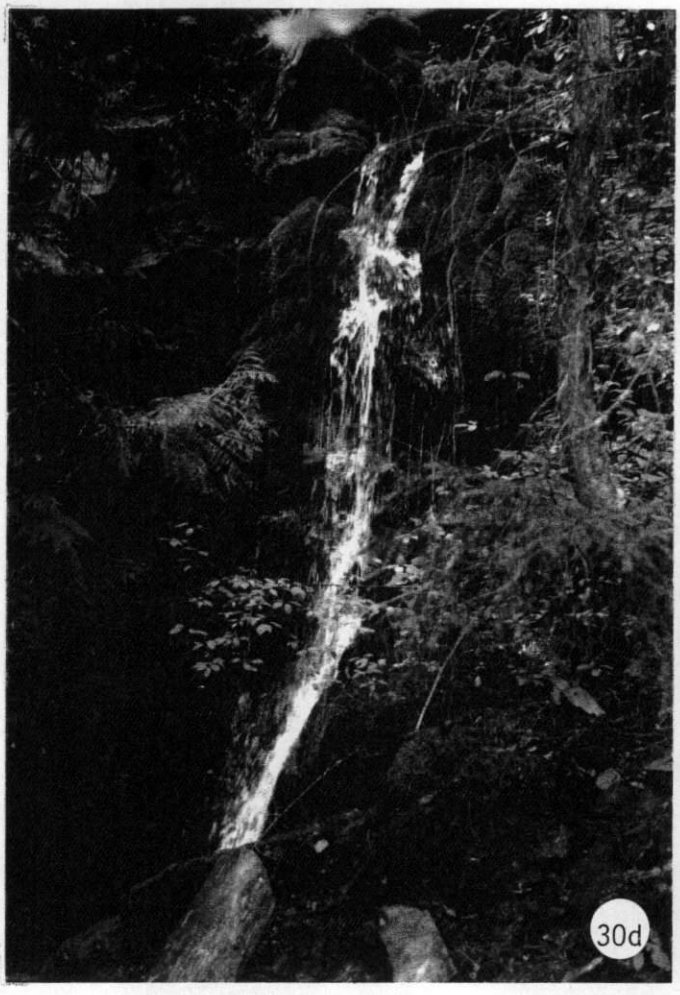
Cascade Creek

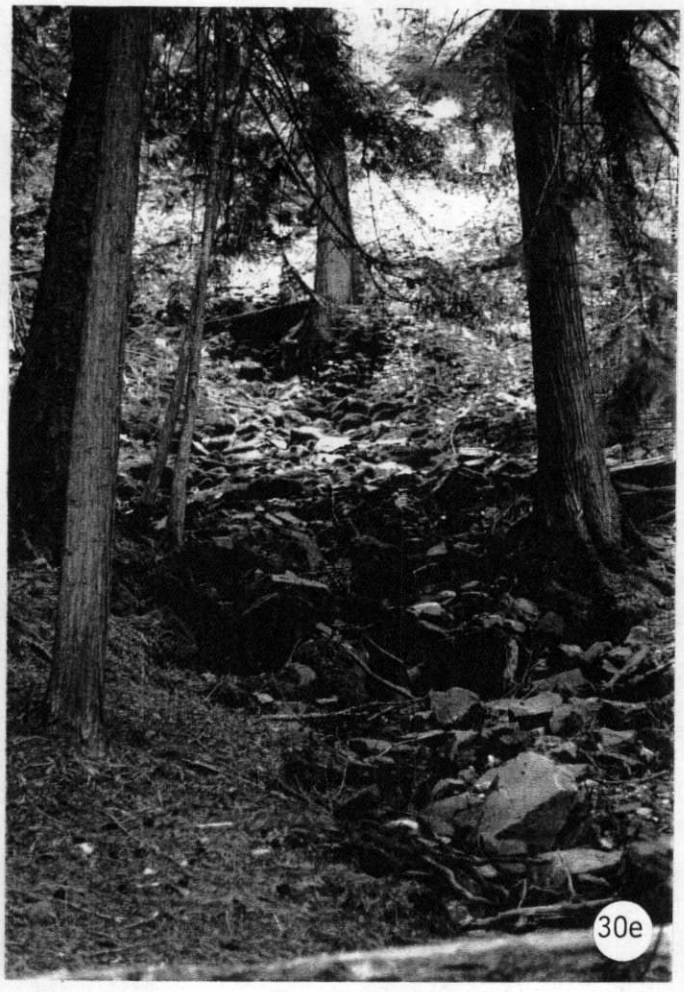
30a. View to west.

30b. Above falls, view to south.

30c. Upper fall, view to southwest.

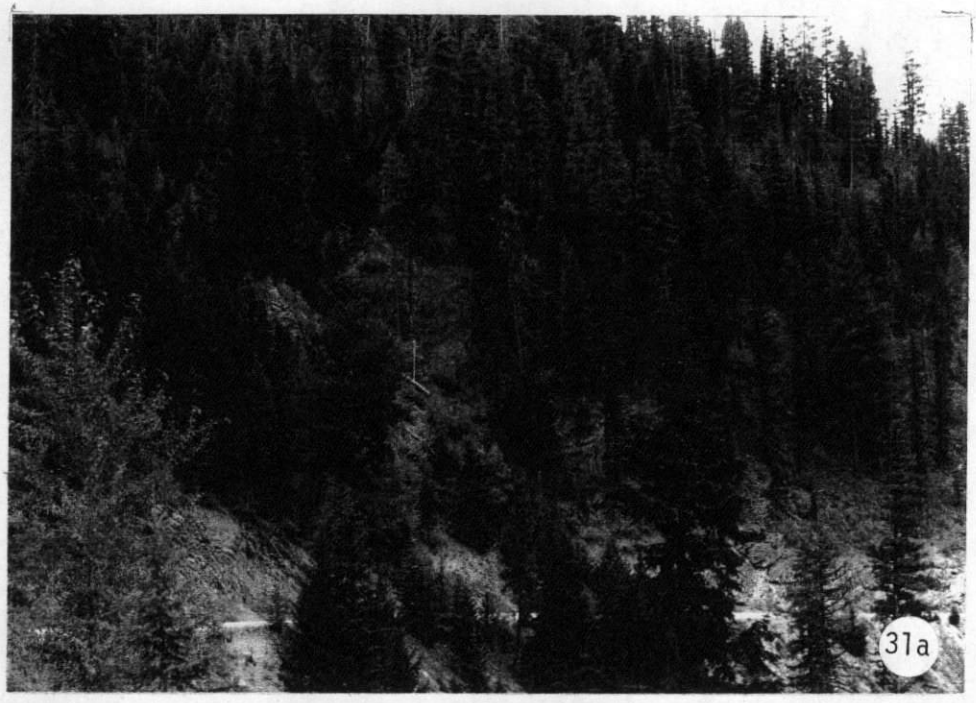


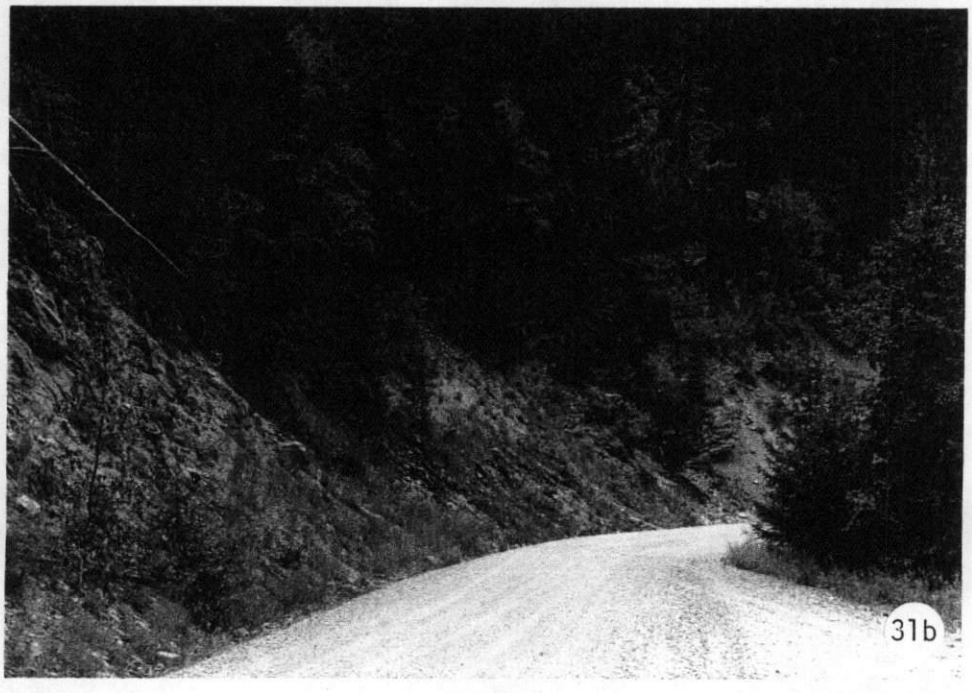




30d. Lower fall, view to south.

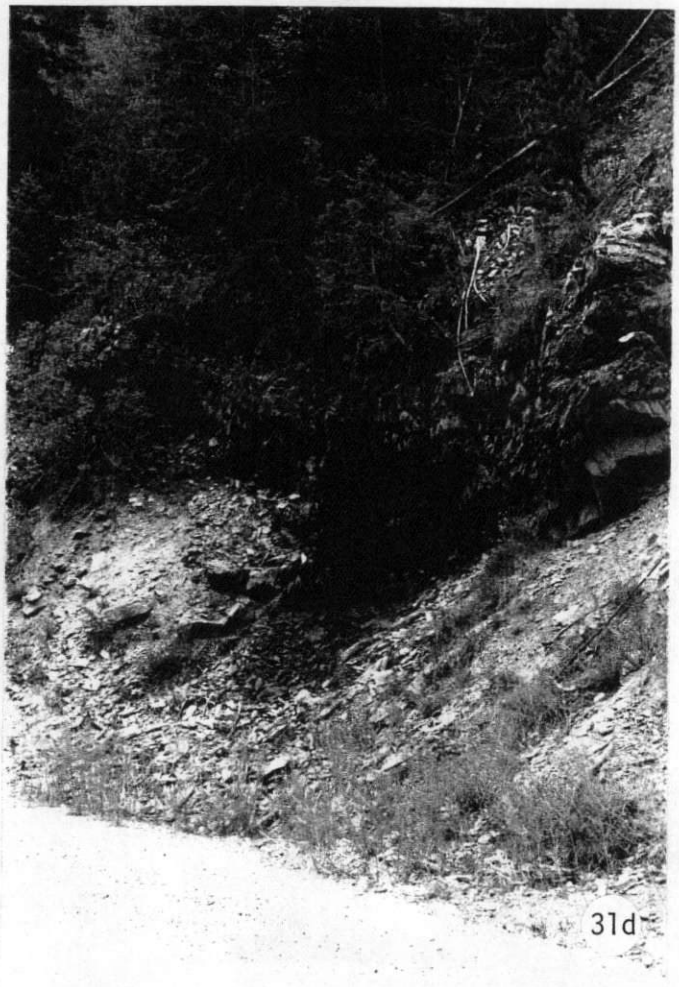
30e. Below falls, view to southwest.





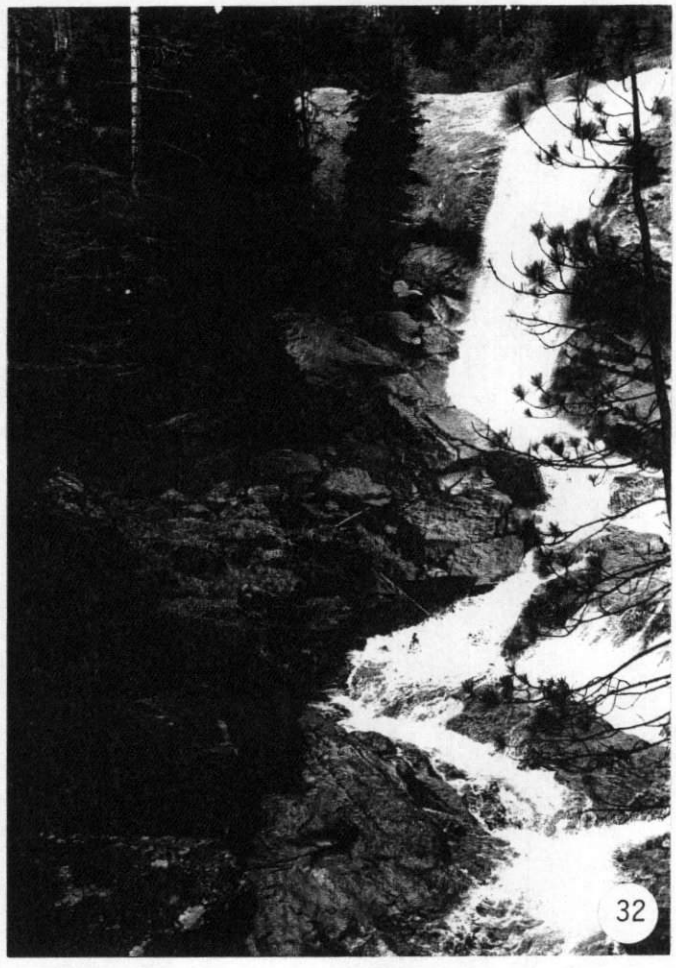
31a. View to north.

31b. View to northeast.



31d. Site of capture, view to northwest.

31c. Seepage above culvert, view to northwest.



32. View to northwest. Site of capture in center of picture near stick.